### Child-Specific Exposure Factors Handbook



#### Chapter 3 - Water Ingestion

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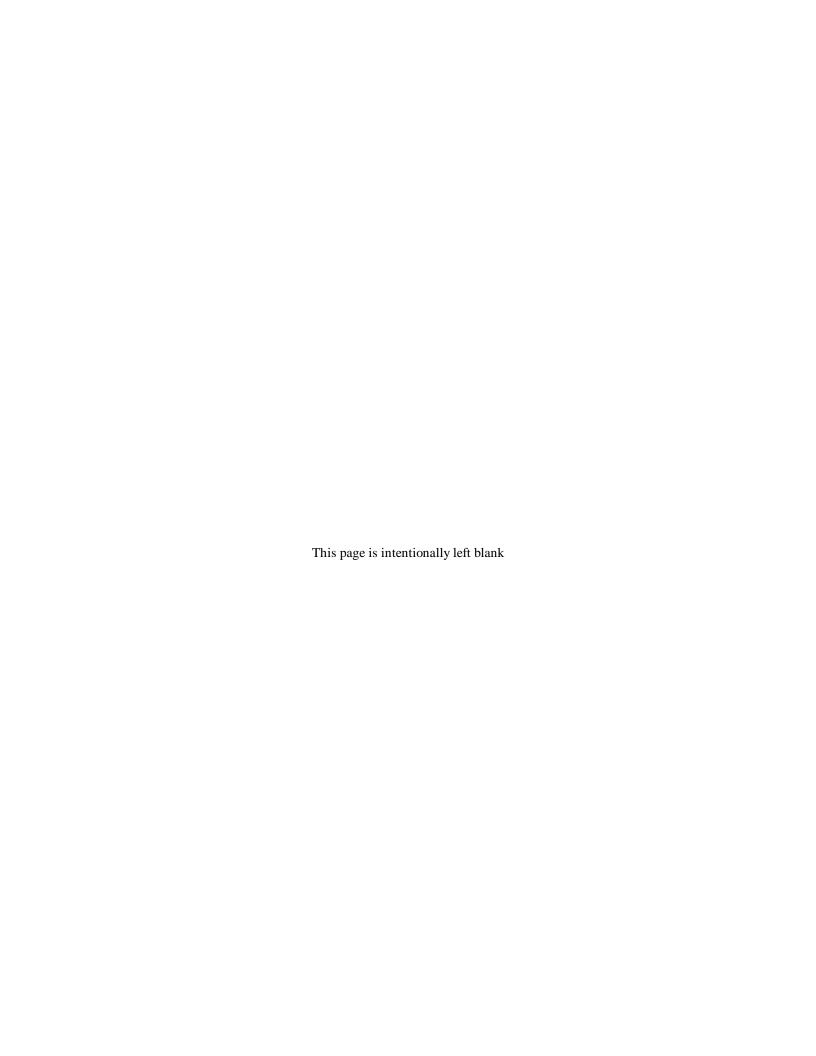
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## 3 INGESTION OF WATER AND OTHER SELECT LIQUIDS

#### 3.1 INTRODUCTION

Water ingestion can be a pathway of exposure to environmental chemicals among children. Contamination of water may occur at the water supply source (ground water or surface water); during treatment (for example toxic by-products may be formed during chlorination); or post-treatment (such as leaching of lead or other materials from plumbing systems). Children may be exposed to contaminants in water when consuming water directly as a beverage, indirectly from foods and drinks made with water, or incidentally while swimming. Estimating the magnitude of the potential dose of toxics from water ingestion requires information on the quantity of water consumed. The purpose of this section is to describe key and relevant published studies that provide information on water ingestion among children and to provide recommended ingestion rate values for use in exposure assessments. The studies described in this section provide information on ingestion of water consumed as a beverage, ingestion of other select liquids, and ingestion of water while swimming.

Currently, the U.S. EPA uses the quantity 1 L per day for infants (individuals of 10 kg body mass or less) and children as a default drinking water ingestion rate (U.S. EPA, 2000). This rate includes water consumed in the form of juices and other beverages containing tapwater. The National Academy of Sciences (NAS, 1977) estimated that daily consumption of water may vary with levels of physical activity and fluctuations in temperature and humidity. It is reasonable to assume that children engaging in physically-demanding activities or living in warmer regions may have higher levels of water ingestion. However, there is limited information on the effects of activity level and climatic conditions on water ingestion.

Various studies cited in this section have generated data on water ingestion rates; in general, these sources support U.S. EPA's use of 1 L/day as an upper-percentile tapwater ingestion rate for children under 10 years of age. Based on the applicability of the survey design to exposure assessments of the entire US population, the study by Khan and Stralka (2008) was selected as a key study of drinking water ingestion. In this study, ingestion rates for direct and indirect ingestion of water are reported. *Direct ingestion* is defined as direct consumption of water as a beverage, while *indirect ingestion* includes water added during food preparation, but not water intrinsic to purchased

foods (i.e. water that is naturally contained in foods) (Kahn and Stralka, 2008). Data for consumption of water from various sources (i.e., the community water supply, bottled water, and other sources) are also presented. For the purposes of exposure assessments involving site-specific contaminated drinking water, ingestion rates based on the community supply are most appropriate. Given the assumption that bottled water, and purchased foods and beverages that contain water are widely distributed and less likely to contain source-specific water, the use of total water ingestion rates may overestimate the potential exposure to toxic substances present only in local water supplies; therefore, tapwater ingestion of community water, rather than total water ingestion, is emphasized in this section.

The studies on water ingestion that are currently available are based on short-term survey data (two days). Although short-term data may be suitable for obtaining mean or median ingestion values that are representative of both short- and long-term ingestion distributions, upper and lower -percentile values may be different for short-term and long-term data. It should also be noted that most currently available water ingestion surveys are based on recall. This may be a source of uncertainty in the estimated ingestion rates because of the subjective nature of this type of survey technique. Percentile distributions for water ingestion are presented in this handbook, where sufficient data are available. Data were not available to estimate drinking water ingestion rates for children during high activity levels or in extreme climates (i.e., hot weather). Also, data are not provided for the location of water consumption (i.e., home, school, day care center, etc.).

Limited information was available regarding children's incidental ingestion of water while swimming. This exposure pathway may be important since children are likely to ingest larger volumes of water while swimming compared to adults; and therefore, may have a greater exposure to pathogenic microorganisms and chemicals present in the water than adults. A recent pilot study (Dufour et al., 2006) has provided some quantitative experimental data on water ingestion for child and adult swimmers. These data are provided in this chapter.

The recommendations for water ingestion rates are provided in the next section, along with a summary of the confidence ratings for these recommendations. The recommended values are based on the key study identified by U.S. EPA for this factor. Following the recommendations, the key study on



water ingestion is summarized. Relevant data on ingestion of water and other select liquids are also provided. These studies are presented to provide the reader with added perspective on the current state-of-knowledge pertaining to ingestion of water and select liquids.

#### 3.2 RECOMMENDATIONS

# 3.2.1 Water Ingestion from Consumption of Water as a Beverage and from Food and Drink

The recommended water ingestion rates for children are based on Kahn and Stralka (2008 and supplementary data). This study presents estimates of water ingestion by age range categories for the population of the United States using data collected in the U.S. Department of Agriculture's (USDA's) 1994-96 and 1998 Continuing Survey of Food Intakes by Individuals (CSFII) (USDA, 1998). A summary of the recommended values for water ingestion rates is presented in Table 3-1. A characterization of the overall confidence in the accuracy and appropriateness of the recommendations for drinking water intake is presented in Table 3-2.

#### 3.2.2 Water Ingestion while Swimming

Based on the results of the Dufour et al. (2006) study, a mean water ingestion rate of 50 mL/hour for children ages 6 to 15 years is recommended for exposure scenarios involving swimming activities. The recommended upper percentile value is 100 mL/hour. The recommended values for children between 18 and 21 years of age are based on the results for adults from Dufour et al. (2006). The mean value is 20 mL/hour and the upper percentile value is 70 mL/hour. Although this estimate was derived from swimming pool experiments, Dufour et al. (2006) noted that swimming behavior of pool swimmers may be similar to freshwater swimmers. Estimates may be different for salt water swimmers. The confidence ratings for these recommendations are presented in Table 3-3. Data on the amount of time spent swimming can be found in chapter 16, Table 16-21.

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| A C               | N                | <b>l</b> ean     | 95 <sup>th</sup> P | ercentile        | Multiple    | Source                  |
|-------------------|------------------|------------------|--------------------|------------------|-------------|-------------------------|
| Age Group         | mL/day           | mL/kg-day        | mL/day             | mL/kg-day        | Percentiles | Source                  |
|                   |                  |                  | Per Ca             |                  |             |                         |
| Birth to <1 month | 184              | 52               | 839 <sup>b</sup>   | 232 <sup>b</sup> |             |                         |
| 1 to <3 months    | 227              | 48               | 896 <sup>b</sup>   | 205 <sup>b</sup> |             |                         |
| 3 to <6 months    | 362              | 52               | 1,056              | 159              |             |                         |
| 6 to <12 months   | 360              | 41               | 1,055              | 126              |             |                         |
| 1 to <2 years     | 271              | 23               | 837                | 71               | See Tables  |                         |
| 2 to <3 years     | 317              | 23               | 877                | 60               | 3-4 and 3-9 | Kahn and Stralka (2008) |
| 3 to <6 years     | 380              | 22               | 1,078              | 61               | 3 4 and 3 7 |                         |
| 6 to <11 years    | 447              | 16               | 1,235              | 43               |             |                         |
| 11 to <16 years   | 606              | 12               | 1,727              | 34               |             |                         |
| 16 to <18 years   | 731              | 11               | 1,983 <sup>b</sup> | 31 <sup>b</sup>  |             |                         |
| 18 to <21 years   | 826              | 12               | $2,540^{b}$        | 35 <sup>b</sup>  |             |                         |
|                   |                  |                  | Consume            | rs Only          |             |                         |
| Birth to <1 month | 470 <sup>b</sup> | 238 <sup>b</sup> |                    |                  |             |                         |
| 1 to <3 months    | 552              | 119              | 1,053 <sup>b</sup> | 285 <sup>b</sup> |             |                         |
| 3 to <6 months    | 556              | 80               | $1,171^{b}$        | 173 <sup>b</sup> |             |                         |
| 6 to <12 months   | 467              | 53               | 1,147              | 129              |             |                         |
| 1 to <2 years     | 308              | 27               | 893                | 75               | See Tables  |                         |
| 2 to <3 years     | 356              | 26               | 912                | 62               | 3-14 and 3- | Kahn and Stralka (2008) |
| 3 to <6 years     | 417              | 24               | 1,099              | 65               | 19          |                         |
| 6 to <11 years    | 480              | 17               | 1,251              | 45               |             |                         |
| 11 to <16 years   | 652              | 13               | 1,744              | 34               |             |                         |
| 16 to <18 years   | 792              | 12               | 2,002 <sup>b</sup> | 32 <sup>b</sup>  |             |                         |
| 18 to <21 years   | 895              | 13               | $2,565^{b}$        | 35 <sup>b</sup>  |             |                         |

<sup>&</sup>lt;sup>a</sup> Ingestion rates for combined direct and indirect water from community water supply.

The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

| General Assessment Factors      | Rationale  | Rating         |
|---------------------------------|--|----------------|
| Soundness                       |  | Medium to High |
| Adequacy of Approach            | The survey methodology and data analysis was adequate. The survey sampled approximately 10,000 individuals under the age of 21 years; sample size varied with age.                 | C              |
| Minimal (or defined) Bias       | No physical measurements were taken. The method relied on recent recall of standardized volumes of drinking water containers.  |                |
| Applicability and Utility       |  | Medium to High |
| Exposure Factor of Interest     | The key study was directly relevant to water ingestion.  |                |
| Representativeness              | The data were demographically representative (based on stratified random sample).  |                |
| Currency                        | Data were collected between 1994 and 1998.   |                |
| Data Collection Period          | Data were collected for two non-consecutive days.<br>However, long term variability may be small. Use of a<br>short-term average as a chronic ingestion measure can<br>be assumed. |                |
| Clarity and Completeness        |  | High           |
| Accessibility                   | The CSFII data are publicly available. The Kahn and Stralka (2008) analysis of the CSFII 1994-96, 1998 data was published in a peer-reviewed journal.                              |                |
| Reproducibility                 | The methodology was clearly presented; enough information was included to reproduce the results.   |                |
| Quality Assurance               | Quality assurance of the CSFII data was good; quality control of the secondary data analysis was not well described.   |                |
| Variability and Uncertainty     | described.   | High           |
| Variability in Population       | Full distributions were given in a separate document (Khan and Stralka, 2008b).  | rngn           |
| Uncertainty                     | Except for data collection based on recall, sources of uncertainty were minimal.   |                |
| Evaluation and Review           |  | Medium         |
| Peer Review                     | The USDA CSFII survey received high level of peer review. The Kahn and Stralka (2008) study was published in a peer-reviewed journal.  |                |
| Number and Agreement of Studies | There was 1 key study for drinking water ingestion.  |                |

| Table 3-3. Confi   | dence in Recommendations for Water Ingestion while Swimming   |               |
|--|---|---------------|
| General Assessment Factors   | Rationale   | Rating        |
| Soundness<br>Adequacy of Approach                                  | The approach appears to be appropriate given that cyanuric acid (a tracer used in treated pool water) is not metabolized, but the sample size was small (41 children). The Dufour et al. (2006) study analyzed primary data on water ingestion during swimming. | Medium        |
| Minimal (or defined) Bias  | Data were collected over a period of 45 minutes; this may not accurately reflect the time spent by a recreational swimmer.  |               |
| Applicability and Utility Exposure Factor of Interest              | The key study was directly relevant to water ingestion while swimming.  | Low to Medium |
| Representativeness   | The sample was not representative of the U.S. population. Data cannot be broken out by age categories   |               |
| Currency   | It appears that the study was conducted in 2005.  |               |
| Data Collection Period   | Data were collected over a period of 45 minutes.  |               |
| Clarity and Completeness Accessibility                             | The Dufour et al. (2006) study was published in a peer-reviewed journal.  | Medium        |
| Reproducibility  | The methodology was clearly presented; enough information was included to reproduce the results   |               |
| Quality Assurance  | Quality assurance methods were not described in the study.  |               |
| Variability and Uncertainty Variability in Population              | Only mean values for water ingestion were provided. Data were not broken out by age groups  | Low           |
| Uncertainty  | There were multiple sources of uncertainty (e.g., sample population may not reflect swimming practices for all swimmers, rates based on swimming duration of 45 minutes, differences by age group not defined).   |               |
| Evaluation and Review Peer Review  Number and Agreement of Studies | Dufour et al. (2006) was published in a peer-reviewed journal.  There was 1 study for ingestion of water when swimming.   | Medium        |
| Overall Rating   | There was I study for ingestion of water when swithining.   | Low           |

## 3.3 DRINKING WATER INGESTION STUDIES

#### 3.3.1 Key Drinking Water Ingestion Study

3.3.1.1 Kahn and Stralka, 2008 - Estimated Daily Average Per Capita Water Ingestion by Child and Adult Age Categories Based on USDA's 1994-96 and 1998 Continuing Survey of Food Intakes by Individuals

Kahn and Stralka (2008) analyzed the combined 1994-96 and 1998 Continuing Survey of Food Intakes by Individuals (CSFII) data sets to examine water ingestion rates of adults and children. USDA surveyed households in the United States and District of Columbia and collected food and beverage recall data as part of the CSFII (USDA,1998). In the initial 1994-96 survey, over 15,000 respondents provided data on what they ate and drank over two non-consecutive days. A 1998 supplement, using the same methodology, added responses for approximately 5,000 children aged 9 years and younger to the database. Of the more than 20,000 individuals surveyed, approximately 10,000 were under 21 years of age, and approximately 9,000 were under the age of 11. For both survey days, data were collected by an inhome interviewer. The day two interview was conducted 3 to 10 days later and on a different day of the week. The 1994-96 survey and 1998 supplement are referred to collectively as CSFII 1994-96, 1998. Each individual in the survey was assigned a sample weight based on his or her demographic data. These weights were taken into account when calculating mean and percentile water ingestion rates from various sources.

Khan and Stralka (2008) derived mean and percentile estimates of daily average water ingestion for children in eleven different age categories: <1 month, 1 to <3 months, 3 to <6 months, 6 to <12 months, 1 to <2 years of age, 2 to <3 years, 3 to <6 years, 6 to <11 years, 11 to <16 years, 16 to <18 years, and 18 to <21 years of age. The increased sample size for children younger than 11 years of age (from 4,339 in the initial 1994-96 survey to 9,643 children in the combined 1994-96, 1998 survey) enabled water ingestion estimates to be categorized into the finer age categories recommended by U.S. EPA (2005). Per capita and consumers only water ingestion estimates were reported in the Kahn and Stralka (2008) study for two water source categories: all sources and community water. "All sources" included water from all supply sources such as community water supply

(i.e., tap water), bottled water, other sources, and missing sources. "Community water" included tap water from a community or municipal water supply. Other sources included wells, springs, and cisterns; missing sources represented water sources that the survey respondent was unable to identify. The water ingestion estimates included both water ingested directly as a beverage (direct water) and water added to foods and beverages during final preparation at home or by local food service establishments such as school cafeterias and restaurants (indirect water). Commercial water added by a manufacturer (i.e., water contained in soda or beer) and intrinsic water in foods and liquids (i.e., milk and natural undiluted juice) were not included in the estimates. Kahn and Stralka (2008) only reported the mean, 90th and 95th percentile estimates of per capita and consumers only ingestion. The full distribution of ingestion estimates for various water source categories (all sources, community water, bottled water, and other sources) were provided by the author. Tables 3-4 to 3-7 provide mean and percentile per capita ingestion estimates of total water (combined direct and indirect water) in mL/day for the various water source categories (i.e., community, bottled, other, and all sources). The 90 percent confidence intervals around the estimated means and the 90 percent bootstrap intervals around the 90th and 95th percentiles of total water ingestion from all water sources are presented in Table 3-8. Tables 3-9 to 3-13 present the same information as Tables 3-4 to 3-8 but in units of mL/kg-day. Consumers only combined direct and indirect water ingestion estimates in mL/day for the various source categories are provided in Tables 3-14 to 3-17. Table 3-18 presents confidence and bootstrap intervals for total water ingestion estimates by consumers only from all sources. Tables 3-19 to 3-23 present the same information as Tables 3-14 to 3-18 but in units of mL/kg-day.

The data show that the total quantity of water ingested per unit mass of body weight is at a maximum in the first month of life and decreases with increasing age. The per capita ingestion rate of water from all sources combined for children under 1 month of age is approximately four times higher than that adults, and consumers younger than 1 month of age ingest approximately 8 times the amount of water (all sources combined) as adults (Kahn and Stralka, 2008). The pattern of decreasing water ingestion per unit of body weight is also observed in per capita and consumers only estimates of community water (Tables 3-9 and 3-

## **-**

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19), bottled water (Table 3-10 and 3-20) and other sources (Tables 3-11 and 3-21).

The CSFII 1994-96, 1998 data have both strengths and limitations with regard to estimating water ingestion. These are discussed in detail in U.S. EPA (2004) and Kahn and Stralka (2008). The principal advantages of this survey are (1) that the survey was designed to obtain a statistically valid sample of the entire United States population that included children and low income groups; (2) sample weights were provided that facilitated proper analysis of the data and accounted for non-response; and (3) that the sample size (approximately 10,000 children) is sufficient to allow categorization within narrowly defined age categories. Over sampling of children enhanced the precision and accuracy of the estimates for the child population subsets. One limitation of this survey is that data were collected for only 2 days and does not necessarily represent "usual intake." "Usual dietary intake" refers to the long-term average of daily intakes by an individual. Thus, upper percentile water ingestion estimates based on short-term data may differ from long-term rates because short-term consumption data tend to be inherently more variable. However, Kahn and Stralka (2008) noted that variability due to short term duration of the survey does not result in bias of estimates of overall mean. In addition, the survey was conducted on non-consecutive days, which improves the variance over consecutive days of consumption. However, the two non-consecutive days of data collection, although an advantage over two consecutive days, provide limited information on individual respondents. The two-day mean for an individual can easily be skewed for numerous reasons. Estimation at the individual respondent level was not, however, an objective of the survey. The large sample provides useful information on the overall distribution of ingestion by the population, and should adequately reflect the range among respondent variability. Another limitation of these data is that the survey design, while being well-tailored for the overall population of the United States and conducted throughout the year to account for seasonal variation, is of limited utility for assessing small and potentially at-risk subpopulations based on ethnicity, medical status, geography/climate, or other factors such as activity level.

# 3.3.2 Relevant Drinking Water Ingestion Studies 3.3.2.1 Levy et al., 1995 - Infant Fluoride Intake From Drinking Water Added to Formula, Beverages, and Food

Levy et al. (1995) conducted a study to determine fluoride intake by infants through drinking water and other beverages prepared with water and baby foods. The study was longitudinal and covered the ages from birth to 9 months old. A total of 192 mothers, recruited from the post partum wards of two hospitals in Iowa City, completed mail questionnaires and three-day beverage and food diaries for their infants at ages 6 weeks, and 3, 6, and 9 months of age (Levy et al., 1995). The questionnaire addressed feeding habits, water sources and ingestion, and the use of dietary fluoride supplements during the preceding week (Levy et al., 1995). Data on the quantity of water consumed by itself or as an additive to infant formula, other beverages, or foods were obtained. In addition, the questionnaire addressed the infants' ingestion of cow's milk, breast-milk, ready-tofeed infant products (formula, juices, beverages, baby food), and table foods.

Mothers were contacted for any clarifications of missing data and discrepancies (Levy et al., 1995). Levy et al. (1995) assessed non-response bias and found no significant differences in the reported number of adults or children in the family, water sources, or family income at 3, 6, or 9 months. Table 3-24 provides the range of water ingestion from water by itself and from addition to selected foods and beverages. The percentage of infants ingesting water by itself increased from 28 percent at 6 weeks to 66 percent at 9 months, respectively, and the mean intake increased slightly over this time frame. During this time frame, the largest proportion of the infants' water ingestion (i.e., 36 percent at 9 months to 48 percent at 6 months) came from the addition of water to formula. Levy et al. (1995) noted that 32 percent of the infants at age 6 weeks and 23 percent of the infants at age 3 months did not receive any water from any of the sources studied. Levy et al. (1995) also noted that the proportion of children ingesting some water from all sources gradually increased with age.

The advantages of this study are that it provides information on water ingestion of infants starting at 6 weeks old and the data are for water only and for water added to beverages and foods. The limitations of the study are that the sample size was small for each age group, it captured information from a select geographical location, and data were collected through self reporting. The authors noted, however,

that the three-day diary has been shown to be a valid assessment tool. Levy et al. (1995) also stated that (1) for each time period, the ages of the infants varied by a few days to a few weeks, and are, therefore, not exact and could, at early ages, have an effect on age-specific intake patterns, and (2) the same number of infants were not available at each of the four time periods.

#### 3.3.2.2 Heller et al., 2000 - Water Consumption and Nursing Characteristics of Infants by Race and Ethnicity

Heller et al. (2000) analyzed data from the 1994-96 CSFII to evaluate racial/ethnic differences in the ingestion rates of water in children younger than 2 years old. Using data from 946 children in this age group, the mean amounts of water consumed from eight sources were determined for various racial/ethnic groups, including black non-Hispanic, white non-Hispanic, Hispanic and "other" (Asian, Pacific Islander, American Indian, Alaskan Native, and other non-specified racial/ethnic groups). The sources analyzed included: (1) plain tap water, (2) milk and milk drinks, (3) reconstituted powdered or liquid infant formula made from drinking water, (4) ready-tofeed and other infant formula, (5) baby food, (6) carbonated beverages, (7) fruit and vegetable juices and other noncarbonated drinks, and (8) other foods and beverages. In addition, Heller et al. (2000) calculated mean plain water and total water ingestion rates for children by age, sex, region, urbanicity, and poverty category. Ages were defined as less than 12 months and 12 to 24 months. Region was categorized as Northeast, Midwest, South, and West. The states represented by each of these regions was not reported in Heller et al. (2000). However, it is likely that these regions were defined in the same way as in Sohn et al. (2001). See Section 3.3.2.4 for a discussion on the Sohn et al. (2001) study. Urbanicity of the residence was defined as urban (i.e., being in a Metropolitan Statistical Area [MSA], suburban [outside of an MSA], or rural [being in a non-MSA]). Poverty category was derived from the poverty income ratio. In this study, a poverty income ratio was calculated by dividing the family's annual income by the federal poverty threshold for that size household. The poverty categories used were 0-1.30, 1.31-3.50, and greater than 3.50 times the federal poverty level (Heller et al., 2000).

Table 3-25 provides water ingestion estimates for the eight water sources evaluated, for each of the

race/ethnic groups. Heller et al. (2000) reported that black non-Hispanic children had the highest mean plain tap water intake (21.3 mL/kg-day), and white non-Hispanic children had the lowest mean plain tap water intake (12.7 mL/kg-day). The only statistically significant difference between the racial/ethnic groups was found to be in plain tap water consumption and total water consumption. Reconstituted baby formula made up the highest proportion of total water intake for all race/ethnic groups. Table 3-26 presents tap water and total water ingestion by age, sex, region, urbanicity, and poverty category. On average, children younger than 12 months of age consumed less plain tap water (11.0 mL/kg-day) than children aged 12-24 months (17.7 mL/kg-day). There were no significant differences in plain tap water consumption by sex, region, or urbanicity. Heller et al. (2000) reported a significant association between higher income and lower plain tap water consumption. For total water consumption, ingestion per kg body weight was lower for the 12-24-month-old children than for those younger than 12 months of age. Urban children consumed more plain tap water and total water than suburban and rural children. In addition, plain tap water and total water ingestion was found to decrease with increasing poverty category (i.e., higher wealth).

A major strength of the Heller et al. (2000) study is that it provides information on tap water and total water consumption by race, age, sex, region, urbanicity, and family income. The weaknesses in the CSFII data set have been discussed under Kahn and Stralka (2008) and U.S. EPA (2004) and include surveying participants for only two days.

#### 3.3.2.3 Sichert-Hellert et al., 2001 - Fifteen Year Trends in Water Intake in German Children and Adolescents: Results of the DONALD Study

Water and beverage consumption was evaluated by Sichert-Hellert et al. (2001) using 3-day dietary records of 733 children, ages 2 to 13 years, enrolled in the Dortmund Nutritional and Anthropometric Longitudinally Designed Study (DONALD study). The DONALD study is a cohort study, conducted in Germany, that collects data on diet, metabolism, growth and development from healthy subjects between infancy and adulthood (Sichert-Hellert et al., 2001). Beginning in 1985, approximately 40 to 50 infants were enrolled in the study annually. Mothers of the participants were

recruited in hospital maternity wards. Older children and parents of younger children were asked to keep dietary records for three days by recording and weighing (to the nearest 1 gram) all foods and fluids, including water, consumed.

Sichert-Hellert et al. (2001) evaluated 3,736 dietary records from 733 subjects (354 males and 379 females) collected between 1985 and 1999. Total water ingestion was defined as the sum of water content from food (intrinsic water), beverages and oxidation. Beverages included milk, mineral water, tap water, juice, soft drinks, and coffee and tea. Table 3-27 presents the mean water ingestion rates for these different sources, as well as mean total water ingestion rates for three age ranges of children (age 2 to 3 years, age 4 to 8 years, and age 9 to 13 years). According to Sichert-Hellert et al. (2001), mean total water ingestion increased with age from 1,114 mL/day in the 2 to 3 year old subjects to 1,891 and 1,676 mL/day in 9 to 13-year-old boys and girls, respectively. However, mean total water intake per body weight decreased with age. Sichert-Hellert et al. (2001) observed that the most important source of total water ingestion was mineral water for all children, except the 2 to 3 year olds. For these children, the most important source of total water ingestion was milk.

One of the limitations of this study is that it evaluated water and beverage consumption in German children and, as such, it may not be representative of consumption patterns of U.S. children.

#### 3.3.2.4 Sohn et al., 2001 - Fluid Consumption Related to Climate Among Children in the United States

Sohn et al. (2001) investigated the relationship between fluid consumption among children aged I to 10 years and local climate using data from the third National Health and Nutrition Examination Survey (NHANES III, 1988-94). Children aged 1 to 10 years who completed the 24hour dietary interview (or proxy interview for the younger children) during the NHANES III survey were selected for the analysis. Breast-fed children were excluded from the analysis. Among 8,613 children who were surveyed, 688 (18 percent) were excluded due to incomplete data. A total of 7,925 eligible children remained. Since data for climatic conditions were not collected in the NHANES III survey, the mean daily maximum temperature from 1961 to 1990, averaged for the month during which the NHANES III survey was conducted, was obtained for each survey location from the U.S. Local Climate Historical Database. Of the 7,925 eligible children with complete dietary data, temperature information was derived for only 3,869 children (48.8 percent) since detailed information on survey location, in terms of county and state, was released only for counties with a population of more than a half million

Sohn et al. (2001) calculated the total amount of fluid intake for each child by adding the fluid intake from plain drinking water and the fluid intake from foods and beverages other than plain drinking water provided by NHANES III. Sohn et al. (2001) identified major fluid sources as milk (and milk drinks), juice (fruit and vegetable juices and other noncarbonated drinks), carbonated drinks, and plain water. Fluid intake from sources other than these major sources were all grouped into other foods and beverages. Other foods and beverages included bottled water, coffee, tea, baby food, soup, water-based beverages, and water used for dilution of food. Mean fluid ingestion rates of selected fluids for the total sample population and for the subsets of the sample population with and without temperature information are presented in Table 3-28. The estimated mean total fluid and plain water ingestion rates for the 3,869 children for whom temperature information was obtained are presented in Table 3-29 according to age (years), sex, race/ethnicity, poverty/income ratio, region, and urban or rural. Poverty/income ratio was defined as the ratio of the reported family income to the federal poverty level. The following categories were assigned: low socioeconomic status (SES) = 0.000-1.300 times the poverty/income ratio; medium SES = 1.3.01-3.500 times the poverty/income level; and high SES = 3.501 or greater times the poverty/income level. Regions were as Northeast, Midwest, South, and West, as defined by the U.S. Census (see Table 3-29). Sohn et al. (2001) did not find significant association between mean daily maximum temperature and total fluid or plain water ingestion, either before or after controlling for sex, age, SES and race or ethnicity. However, significant associations between fluid ingestion and age, sex, socioeconomic status and race and ethnicity were reported.

The main strength of the Sohn et al. (2001) study is the evaluation of water intake as it relates to weather data. The main limitations of this study were that northeast and western regions were over represented since temperature data was only available for counties with populations in excess of a half

million. In addition, whites were under-represented compared to other racial or ethnic groups. Other limitations include lack of data for children from extremely cold or hot weather conditions.

# 3.3.2.5 Hilbig et al., 2002 - Measured Consumption of Tap Water in German Infants and Young Children as Background for Potential Health Risk Assessment: Data of the DONALD Study

Hilbig et al. (2002) estimated tap water ingestion rates based on 3-day dietary records of 504 German children aged 3, 6, 9, 12, 18, 24 and 36 months. The data were collected between 1990 and 1998 as part of the DONALD study. Details of data collection for the DONALD study have been provided previously under the Sichert-Hellert et al. (2001) study in Section 3.3.2.3 of this handbook. Tap water ingestion rates were calculated for three subgroups of children: (1) breast-fed infants ≤12 months of age (exclusive and partial breast-fed infants) (2) formulafed infants ≤12 months of age (no human milk, but including weaning food) and (3) mixed-fed young children aged 18 to 36 months. Hilbig et al. (2002) defined "total tap water from household" as water from the tap consumed as a beverage or used in food preparation. "Tap water from food manufacturing" was defined as water used in industrial production of foods, and "Total Tap Water" was defined as tap water consumed from both the household and that used in manufacturing.

Table 3-30 summarizes total tap water ingestion (in mL/day and mL/kg-day) and tap water ingestion from household and manufacturing sources (in mL/kg-day) for breastfed, formula fed and mixed-fed children. Mean total tap water intake was higher in formula-fed infants (53 mL/kg-day) than in breastfed infants (17 g/kg-day) and mixed-fed young children (19 g/kg-day). Tap water from household sources constituted 66 to 97 percent of total tap water ingestion in the different age groups.

The major limitation of this study is that the study sample consists of families from an upper social background in Germany (Hilbig et al., 2002). Because the study was conducted in Germany, the data may not be directly applicable to the U.S. population.

#### 3.3.2.6 Marshall et al., 2003a - Patterns of Beverage Consumption During the Transition Stage of Infant Nutrition

Marshall et al. (2003a) investigated beverage ingestion during the transition stage of infant nutrition. Mean ingestion of infant formula, cow's milk, combined juice and juice drinks, water, and other beverages were estimated using a frequency questionnaire. A total of 701 children, ages six months through 24 months, participated in the Iowa Fluoride Study (IFS). Mothers of newborns were recruited from 1992 through 1995. The parents were sent questionnaires when the children were 6, 9, 12, 16, 20, and 24 months old. Of the 701 children, 470 returned all six questionnaires, 162 returned five, 58 returned four and 11 returned three, with the minimum criteria being three questionnaires to be included in the data set (Marshall et al., 2003a). The questionnaire was designed to assess the type and quantity of the beverages consumed during the previous week. The validity of the questionnaire was assessed using a three-day food diary for reference (Marshall et al., The percentage of subjects consuming beverages and mean daily beverage ingestion for children with returned questionnaires are presented in Table 3-31. Human milk ingestion was not quantified, but the percent of children consuming human milk was provided at each age category (Table 3-31). Juice (100 percent) and juice drinks were not distinguished separately, but categorized as juice and juice drinks. Water used to dilute beverages beyond normal dilution and water consumed alone were combined. Based on Table 3-31, 97 percent of the children consumed human milk, formula, or cow's milk throughout the study period, and the percentage of infants consuming human milk decreased with age, while the percent consuming water increased (Marshall et al., 2003a). Marshall et al. (2003a) observed that in general, lower family incomes were associated with less breastfeeding and increased ingestion of other beverages.

The advantage of this study is that it provides mean ingestion data for various beverages. Limitations of the study are that the it is based on samples gathered in one geographical area and may not be reflective of the general population. The authors also noted the following limitations: the parents were not asked to differentiate between 100 percent juice and juice drinks; the data are parent-reported and could reflect perceptions of appropriate ingestion instead of actual ingestion, and a substantial

number of the infants from well educated, economically secure households dropped out during the initial phase.

# 3.3.2.7 Marshall et al., 2003b - Relative Validation of a Beverage Frequency Questionnaire in Children Ages 6 Months through 5 Years Using 3-day Food and Beverage Diaries

This study was based on data taken from 700 children in the IFS. This study compared estimated beverage ingestion rates reported in questionnaires for the preceding week and dairies for the following week. Packets were sent periodically (every 4 to 6 months) to parents of children aged 6 weeks through 5 years of age. This study analyzed data from children, ages 6 and 12 months, and 2 and 5 years of age. Beverages were categorized as human milk, infant formula, cow's milk, juice and juice drinks, carbonated and rehydration beverages, prepared drinks (from powder) and water. The beverage questionnaire was completed by parents and summarized the average amount of each beverage consumed per day by their children. The data collection for the diaries maintained by parents included 1 weekend day and 2 week days and included detailed information about beverages consumed. Table 3-32 presents the mean ingestion rates of all beverages for children aged 6 and 12 months and 3 and 5 years. Marshall et al. (2003b) concluded that estimates of beverage ingestion derived from quantitative questionnaires are similar to those derived from diaries. They found that it is particularly useful to estimate ingestion of beverages consumed frequently using quantitative questionnaires.

The advantage of this study is that the survey was conducted in two different forms (questionnaire and diary) and that diaries for recording beverage ingestion were maintained by parents for three days. The main limitation is the lack of information regarding whether the diaries were populated on consecutive or non-consecutive days. The IFS survey participants may not be representative of the general population of the U.S. since participants were primarily white, and from affluent and well-educated families in one geographic region of the country.

## 3.3.2.8 Skinner et al., 2004 - Transition in Infants' and Toddlers' Beverage Patterns

Skinner et al. (2004) investigated the pattern of beverage consumption by infants and children participating in the Feeding Infant and Toddlers Study (FITS) sponsored by Gerber Products Company. The

FITS is a cross-sectional study designed to collect and analyze data on feeding practices, food consumption, and usual nutrient intake of U.S. infants and toddlers (Devaney et al., 2004). It included a stratified random sample of 3,022 infants and toddlers between 4 and 24 months of age. Parents or primary caregivers of sampled infants and toddlers completed a single 24-hour dietary recall of all foods and beverages consumed by the child on the previous day by telephone interview. All recalls were completed between March and July 2002. Detailed information on data collection, coding and analyses related to FITS are provided in Devaney et al. (2004).

Beverages consumed by FITS participants were identified as total milks (i.e., human milk, infant formulas, cows milk, soy milk, goat milk), 100 percent juices, fruit drinks, carbonated beverages, water and "other" drinks (i.e., tea, cocoa, dry milk mixtures, and electrolyte replacement beverages). There were six age groupings in the FITS study: 4 to 6, 7 to 8, 9 to 11, 12 to 14, 15 to 18, and 19 to 24 months. Skinner et al. (2004) calculated the percentage of children in each age group consuming any amount in a beverage category and the mean amounts consumed. Table 3-33 provides the mean beverage consumption rates in mL/day for the six age categories. Skinner et al. (2004) found that some form of milk beverage was consumed by almost all children at each age; however, total milk ingestion decreased with increasing age. Water consumption also doubled with age, from 163 mL/day in children aged 4 to 6 months old to 337 mL/day at 19 to 24 months old. The percentages of children consuming water increased from 34 percent at 4 to 6 months of age to 77 percent at 19 to 24 months of age.

A major strength of the Skinner et al. (2004) study is the large sample size (3,022 children). However, beverage ingestion estimates are based on one day of dietary recall data and human milk quantity derived from studies that weighed infants before and after each feeding to determine the quantity of human milk consumed (Devaney et al., 2004); therefore, estimates of total milk ingestion may not be accurate.

## 3.4 WATER INGESTION WHILE SWIMMING

#### 3.4.1 Dufour et al., 2006 - Water Ingestion During Swimming Activities in a Pool: A Pilot Study

Dufour et al. (2006) estimated the amount of water ingested while swimming, using cyanuric acid as

an indicator of pool water ingestion exposure. Cyanuric acid is a breakdown product of chloroisocyanates which are commonly used as disinfectant stabilizers in recreational water treatment. Because ingested cyanuric acid passes through the body unmetabolized, the volume of water ingested can be estimated based on the amount of cyanuric acid measured in the pool water and in the urine of swimmers, as follows:

$$V_{\text{pool water ingested}} = V_{\text{urine}} \times CA_{\text{urine}}/CA_{\text{pool}}$$
 (Eqn. 3-1)

#### where:

 $V_{pool \, water \, ingested}$  = volume of pool water ingested

(mL)

 $V_{urine} \hspace{1.5cm} = \hspace{.5cm} volume \ of \ urine \ collected \ over \ a$ 

24-hour period (mL)

CA<sub>urine</sub> = concentration of cyanuric acid

in urine (mg/L)

 $CA_{pool}$  = concentration of cyanuric acid

in pool water (mg/L)

Dufour et al. (2006) estimated pool water intake among 53 swimmers that participated in a pilot study at an outdoor swimming pool treated with chloroisocyanate. This pilot study population included 12 adults (4 males and 8 females) and 41 children between 6 and 15 years of age (20 males and 21 females). The study participants were asked not to swim for 24 hours before or after a 45 minute period of active swimming in the pool. Pool water samples were collected prior to the start of swimming activities and swimmers' urine was collected for 24 hours after the swimming event ended. The pool water and urine sample were analyzed for cyanuric acid.

The results of this pilot study are presented in Table 3-34. The mean volume of water ingested by children over a 45-minute period was 37 mL. The maximum volume of water ingested by children was 154 mL/45 minutes and the 97th percentile was 90 mL. Individuals older than 18 years of age ingested an average of 16 mL over a 45-minute period; the maximum amount ingested by these individuals was 53mL over a 45-minute period. The mean ingestion rates for males tended to be higher than that of females, but these differences were not statistically significant. The advantages of this study is that it is one of the first attempts to measure water ingested while swimming. However, the number of study

participants was low and data cannot be broken out by the recommended age categories. As noted by the Dufour et al. (2006), swimming behavior of pool swimmers may be similar to freshwater swimmers, but may differ from salt water swimmers.

Based on the results of the Dufour et al. (2006) study, the recommended mean water ingestion rate for exposure scenarios involving swimming activities is 50 mL/hour for children under 16 years of age (37 mL/0.75 hour, rounded to one significant figure) and the upper percentile value is 100 mL/hour (90 mL/0.75 hour, rounded to one significant figure). For children, ages 18 to <21 years, the recommended mean water ingestion rate for scenarios involving swimming activities is 20 mL/hour (16 mL/0.75 hour, rounded to one significant figure). Because the data set is limited, the upper percentile water ingestion rate for 18 to <21 year olds is based on the maximum value observed in adults in the Dufour et al. (2006) study: 70 mL/hour (53 mL/0.75 hour, rounded to one significant figure).

#### 3.5 REFERENCES FOR CHAPTER 3

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Table 3-4. Per Capita<sup>a</sup> Estimates of Combined Direct and Indirect<sup>b</sup> Water Ingestion: Community Water (mL/day)

| A                 | Sample | M      |    |     |     | Percentiles |       |        |        |
|-------------------|--------|--------|----|-----|-----|-------------|-------|--------|--------|
| Age               | size   | Mean - | 10 | 25  | 50  | 75          | 90    | 95     | 99     |
| Birth to <1 month | 91     | 184    | -  | -   | -   | 322         | 687*  | 839*   | 860*   |
| 1 to <3 months    | 253    | 227    | -  | -   | -   | 456         | 804   | 896*   | 1,165* |
| 3 to <6 months    | 428    | 362    | -  | -   | 148 | 695         | 928   | 1,056  | 1,424* |
| 6 to <12 months   | 714    | 360    | -  | 17  | 218 | 628         | 885   | 1,055  | 1,511* |
| 1 to <2 years     | 1,040  | 271    | -  | 60  | 188 | 402         | 624   | 837    | 1,215* |
| 2 to <3 years     | 1,056  | 317    | -  | 78  | 246 | 479         | 683   | 877    | 1,364* |
| 3 to <6 years     | 4,391  | 380    | 4  | 98  | 291 | 547         | 834   | 1,078  | 1,654  |
| 6 to <11 years    | 1,670  | 447    | 22 | 133 | 350 | 648         | 980   | 1,235  | 1,870* |
| 11 to <16 years   | 1,005  | 606    | 30 | 182 | 459 | 831         | 1,387 | 1,727  | 2,568* |
| 16 to <18 years   | 363    | 731    | 16 | 194 | 490 | 961         | 1,562 | 1,983* | 3,720* |
| 18 to <21 years   | 389    | 826    | 24 | 236 | 628 | 1,119       | 1,770 | 2,540* | 3,889* |

<sup>&</sup>lt;sup>a</sup> Includes all participants whether or not they ingested any water from the source during survey period.

Source: Kahn and Stralka, 2008 and supplementary data.

| A                 | Sample | M =    |    |    |    | Percentile | S    |         |        |
|-------------------|--------|--------|----|----|----|------------|------|---------|--------|
| Age               | size   | Mean - | 10 | 25 | 50 | 75         | 90   | 95      | 99     |
| Birth to <1 month | 91     | 104    | -  | -  | -  | 18         | 437* | 556*    | 1,007* |
| 1 to <3 months    | 253    | 106    | -  | -  | -  | -          | 541  | 771*    | 1,056* |
| 3 to <6 months    | 428    | 120    | -  | -  | -  | -          | 572  | 774     | 1,443* |
| 6 to <12 months   | 714    | 120    | -  | -  | -  | 53         | 506  | 761     | 1,284* |
| 1 to <2 years     | 1,040  | 59     | -  | -  | -  | -          | 212  | 350     | 801*   |
| 2 to <3 years     | 1,056  | 76     | -  | -  | -  | -          | 280  | 494     | 1,001* |
| 3 to <6 years     | 4,391  | 84     | -  | -  | -  | -          | 325  | 531     | 1,031* |
| 6 to <11 years    | 1,670  | 84     | -  | -  | -  | -          | 330  | 532     | 1,079* |
| 11 to <16 years   | 1,005  | 111    | -  | -  | -  | -          | 382  | 709     | 1,431* |
| 16 to <18 years   | 363    | 109    | -  | -  | -  | -          | 426  | 680*    | 1,605* |
| 18 to <21 years   | 290    | 105    |    |    |    |            | 514  | 1 1/11* | 2 264* |

<sup>&</sup>lt;sup>a</sup> Includes all participants whether or not they ingested any water from the source during survey period.

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

 <sup>=</sup> Zero.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>- =</sup> Zero

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

| A                 | Sample | M =    | Percentiles |    |    |    |     |      |        |
|-------------------|--------|--------|-------------|----|----|----|-----|------|--------|
| Age               | size   | Mean - | 10          | 25 | 50 | 75 | 90  | 95   | 99     |
| Birth to <1 month | 91     | 13     | -           | -  | -  | -  | -   | -    | 393*   |
| 1 to <3 months    | 253    | 35     | -           | -  | -  | -  | -   | 367* | 687*   |
| 3 to <6 months    | 428    | 45     | -           | -  | -  | -  | -   | 365  | 938*   |
| 6 to <12 months   | 714    | 45     | -           | -  | -  | -  | 31  | 406  | 963*   |
| 1 to <2 years     | 1,040  | 22     | -           | -  | -  | -  | -   | 118  | 482*   |
| 2 to <3 years     | 1,056  | 39     | -           | -  | -  | -  | 52  | 344  | 718*   |
| 3 to <6 years     | 4,391  | 43     | -           | -  | -  | -  | 58  | 343  | 830    |
| 6 to <11 years    | 1,670  | 61     | -           | -  | -  | -  | 181 | 468  | 1,047* |
| 11 to <16 years   | 1,005  | 102    | -           | -  | -  | -  | 344 | 786  | 1,698* |
| 16 to <18 years   | 363    | 97     | -           | -  | -  | -  | 295 | 740* | 1,760* |
| 18 to <21 years   | 389    | 47     | _           | _  | _  | _  | _   | 246* | 1 047* |

<sup>&</sup>lt;sup>a</sup> Includes all participants whether or not they ingested any water from the source during survey period.

Source: Kahn and Stralka, 2008 and supplementary data.

| <b>A</b>          | Sample |        |     |     |     | Percentiles |       |        |        |
|-------------------|--------|--------|-----|-----|-----|-------------|-------|--------|--------|
| Age               | size   | Mean - | 10  | 25  | 50  | 75          | 90    | 95     | 99     |
| Birth to <1 month | 91     | 301    | -   | -   | 135 | 542         | 846*  | 877*   | 1,088* |
| 1 to <3 months    | 253    | 368    | -   | -   | 267 | 694         | 889   | 1,020* | 1,265* |
| 3 to <6 months    | 428    | 528    | -   | 89  | 549 | 812         | 1,025 | 1,303  | 1,509* |
| 6 to <12 months   | 714    | 530    | 37  | 181 | 505 | 771         | 1,029 | 1,278  | 1,690* |
| 1 to <2 years     | 1,040  | 358    | 68  | 147 | 287 | 477         | 735   | 961    | 1,281* |
| 2 to <3 years     | 1,056  | 437    | 104 | 211 | 372 | 588         | 825   | 999    | 1,662* |
| 3 to <6 years     | 4,391  | 514    | 126 | 251 | 438 | 681         | 980   | 1,200  | 1,794  |
| 6 to <11 years    | 1,670  | 600    | 169 | 304 | 503 | 803         | 1,130 | 1,409  | 2,167* |
| 11 to <16 years   | 1,005  | 834    | 224 | 401 | 663 | 1,099       | 1,649 | 1,960  | 3,179* |
| 16 to <18 years   | 363    | 964    | 236 | 387 | 742 | 1,273       | 1,842 | 2,344* | 3,854* |
| 18 to <21 years   | 389    | 1,075  | 189 | 406 | 803 | 1,394       | 2,117 | 2,985* | 4,955* |

Includes all participants whether or not they ingested any water from the source during survey period.

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>=</sup> Zero.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

 <sup>=</sup> Zero

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).



|  |            | -             |                |                |  |                 | 0              |                | ( C                         |                |
|--|------------|---------------|----------------|----------------|--|-----------------|----------------|----------------|-----------------------------|----------------|
|  |            |               | Mean           |                | )6   | 90th percentile | e              | 6              | 95 <sup>th</sup> percentile | 6              |
|  | Sample     |               | %06            | C.I.           |  | %06             | B.I.           |                | %06                         | B.I.           |
| S  | size       | Estimate      | Lower<br>Bound | Upper<br>Bound | Estimate   | Lower<br>Bound  | Upper<br>Bound | Estimate       | Lower<br>Bound              | Upper<br>Bound |
| Birth to <1 month  | 91         | 301           | 215            | 387            | 846*   | 889             | *658           | *178           | *86L                        | *866           |
|  | 253        | 368           | 304            | 432            | 688  | 862             | 968            | 1,020*         | 918*                        | 1,070*         |
|  | 428        | 528           | 485            | 571            | 1,025  | 955             | 1,083          | 1,303          | 1,170                       | 1,351          |
| hs   | 714        | 530           | 495            | 564            | 1,029  | 973             | 1,100          | 1,278          | 1,142                       | 1,385          |
|  | 1,040      | 358           | 338            | 377            | 735  | 989             | 778            | 961            | 879                         | 1,001          |
|  | 1,056      | 437           | 418            | 455            | 825  | 784             | 857            | 666            | 952                         | 1,051          |
|  | 4,391      | 514           | 464            | 533            | 086  | 953             | 1,004          | 1,200          | 1,167                       | 1,240          |
|  | 1,670      | 009           | 571            | 629            | 1,130  | 1,065           | 1,162          | 1,409          | 1,314                       | 1,468          |
| s  | 1,005      | 834           | 770            | 868            | 1,649  | 1,567           | 1,775          | 1,960          | 1,873                       | 2,218          |
|  | 363        | 964           | 870            | 1,057          | 1,842  | 1,743           | 1,988          | 2,344*         | 2,071*                      | 2,599*         |
| 18 to <21 years  | 389        | 1,075         | 086            | 1,171          | 2,117  | 1,952           | 2,299          | 2,985*         | 2,504*                      | 3,785*         |
| a Includes all pa  | articipant | ts whether o  | r not they ir  | gested any     | participants whether or not they ingested any water from the source during survey period | e source du     | ring survey l  | period.        |                             |                |
| b Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or | lefined as | s water inge  | sted directly  | as a bevera    | ge; indirect w   | vater define    | d as water ac  | dded in the pr | eparation of                | food or        |
| beverages.   |            |               |                |                |  |                 |                |                |                             |                |
| * The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United         | ze does r  | not meet mir  | nimum requ.    | irements as    | described in t   | the "Third F    | Report on Nu   | trition Monit  | oring in the                | United         |
| States" (LSRC  | ), 1995).  |               |                |                |  |                 |                |                |                             |                |
|  | Interval.  |               |                |                |  |                 |                |                |                             |                |
| BI = Bootstrap In  | Interval.  |               |                |                |  |                 |                |                |                             |                |
| Source: Kalm and Stralka 2008 and sumplementary data   | 1ka 2008   | 8 and sunnile | mentary da     | <u> 5</u>      |  |                 |                |                |                             |                |

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| <b>A</b>          | Sample |      | Percentiles |    |    |     |      |      |      |  |  |
|-------------------|--------|------|-------------|----|----|-----|------|------|------|--|--|
| Age               | size   | Mean | 10          | 25 | 50 | 75  | 90   | 95   | 99   |  |  |
| Birth to <1 month | 88     | 52   | -           | -  | -  | 101 | 196* | 232* | 253* |  |  |
| 1 to <3 months    | 245    | 48   | -           | -  | -  | 91  | 151  | 205* | 310* |  |  |
| 3 to <6 months    | 411    | 52   | -           | -  | 20 | 98  | 135  | 159  | 216* |  |  |
| 6 to <12 months   | 678    | 41   | -           | 2  | 24 | 71  | 102  | 126  | 185* |  |  |
| 1 to <2 years     | 1,002  | 23   | -           | 5  | 17 | 34  | 53   | 71   | 106* |  |  |
| 2 to <3 years     | 994    | 23   | -           | 6  | 17 | 33  | 50   | 60   | 113* |  |  |
| 3 to <6 years     | 4,112  | 22   | -           | 6  | 17 | 31  | 48   | 61   | 93   |  |  |
| 6 to <11 years    | 1,553  | 16   | 1           | 5  | 12 | 22  | 34   | 43   | 71*  |  |  |
| 11 to <16 years   | 975    | 12   | 1           | 4  | 9  | 16  | 25   | 34   | 54*  |  |  |
| 16 to <18 years   | 360    | 11   | -           | 3  | 8  | 15  | 23   | 31*  | 55*  |  |  |
| 18 to <21 years   | 383    | 12   | 1           | 4  | 10 | 16  | 17   | 35*  | 63*  |  |  |

<sup>&</sup>lt;sup>a</sup> Includes all participants whether or not they ingested any water from the source during survey period.

Source: Kahn and Stralka, 2008 and supplementary data.

|                   | Sample |      |    |    |    | Percentile | S    |      |      |
|-------------------|--------|------|----|----|----|------------|------|------|------|
| Age               | size   | Mean | 10 | 25 | 50 | 75         | 90   | 95   | 99   |
| Birth to <1 month | 88     | 33   | -  | -  | -  | 6          | 131* | 243* | 324* |
| 1 to <3 months    | 245    | 22   | -  | -  | -  | -          | 97   | 161* | 242* |
| 3 to <6 months    | 411    | 16   | -  | -  | -  | -          | 74   | 117  | 193* |
| 6 to <12 months   | 678    | 13   | -  | -  | -  | 4          | 52   | 87   | 139* |
| 1 to <2 years     | 1,002  | 5    | -  | -  | -  | -          | 18   | 28   | 67*  |
| 2 to <3 years     | 994    | 5    | -  | -  | -  | -          | 19   | 35   | 84*  |
| 3 to <6 years     | 4,112  | 5    | -  | -  | -  | -          | 18   | 30   | 59   |
| 6 to <11 years    | 1,553  | 3    | -  | -  | -  | -          | 10   | 18   | 41*  |
| 11 to <16 years   | 975    | 2    | -  | -  | -  | -          | 8    | 14   | 26*  |
| 16 to <18 years   | 360    | 2    | -  | -  | -  | -          | 6    | 10*  | 27*  |
| 18 to <21 years   | 383    | 3    | -  | -  | -  | -          | 8    | 19*  | 34*  |

Includes all participants whether or not they ingested any water from the source during survey period.

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>=</sup> Zero.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>-</sup> = Zero.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

Table 3-11. Per Capita<sup>a</sup> Estimates of Combined Direct and Indirect<sup>b</sup> Water Ingestion: Other Sources (mL/kg-day)

|                   |        |      |    |    |    | 8           |    |     | 8    |
|-------------------|--------|------|----|----|----|-------------|----|-----|------|
| <b>A</b>          | Sample | M    |    |    |    | Percentiles | 1  |     |      |
| Age               | size   | Mean | 10 | 25 | 50 | 75          | 90 | 95  | 99   |
| Birth to <1 month | 88     | 4    | -  | -  | -  | -           | -  | -   | 122* |
| 1 to <3 months    | 245    | 7    | -  | -  | -  | -           | -  | 52* | 148* |
| 3 to <6 months    | 411    | 7    | -  | -  | -  | -           | -  | 55  | 155* |
| 6 to <12 months   | 678    | 5    | -  | -  | -  | -           | 3  | 35  | 95*  |
| 1 to <2 years     | 1,002  | 2    | -  | -  | -  | -           | -  | 11  | 45*  |
| 2 to <3 years     | 994    | 3    | -  | -  | -  | -           | 4  | 23  | 61*  |
| 3 to <6 years     | 4,112  | 2    | -  | -  | -  | -           | 3  | 19  | 48   |
| 6 to <11 years    | 1,553  | 2    | -  | -  | -  | -           | 7  | 16  | 36*  |
| 11 to <16 years   | 975    | 2    | -  | -  | -  | -           | 7  | 14  | 34*  |
| 16 to <18 years   | 360    | 2    | -  | -  | -  | -           | 5  | 11* | 27*  |
| 18 to <21 years   | 383    | 1    | -  | -  | -  | -           | -  | 4*  | 14*  |

Includes all participants whether or not they ingested any water from the source during survey period.

Source: Kahn and Stralka, 2008 and supplementary data.

| A 00              | Sample     | Mean - |    |    |    | Percentiles |      |      |      |
|-------------------|------------|--------|----|----|----|-------------|------|------|------|
| Age               | size       | Mean   | 10 | 25 | 50 | 75          | 90   | 95   | 99   |
| Birth to <1 month | 88         | 89     | -  | -  | 21 | 168         | 235* | 269* | 338* |
| 1 to <3 months    | 245<br>411 | 77     | -  | -  | 46 | 134         | 173  | 246* | 336* |
| 3 to <6 months    | 411        | 75     | -  | 9  | 73 | 118         | 156  | 186  | 225* |
| 6 to <12 months   | 678        | 59     | 4  | 20 | 53 | 86          | 118  | 148  | 194* |
| 1 to <2 years     | 1,002      | 31     | 6  | 13 | 24 | 39          | 63   | 85   | 122* |
| 2 to <3 years     | 994        | 31     | 7  | 15 | 26 | 41          | 59   | 73   | 130* |
| 3 to <6 years     | 4,112      | 29     | 7  | 14 | 25 | 38          | 56   | 69   | 102  |
| 6 to <11 years    | 1,553      | 21     | 6  | 10 | 18 | 27          | 39   | 50   | 76*  |
| 11 to <16 years   | 975        | 16     | 4  | 8  | 13 | 20          | 31   | 39   | 60*  |
| 16 to <18 years   | 360        | 15     | 4  | 6  | 12 | 18          | 28   | 37*  | 59*  |
| 18 to <21 years   | 383        | 16     | 3  | 6  | 12 | 21          | 32   | 41*  | 73*  |

Includes all participants whether or not they ingested any water from the source during survey period.

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>=</sup> Zero.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>=</sup> Zero.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).



|  | Table  | 3-13. Per           | · Capitaª Est | imates of To   | otal Direct a  | Table 3-13. Per Capita <sup>a</sup> Estimates of Total Direct and Indirect <sup>b</sup> Water Ingestion: All Sources (mL/kg-day) | Vater Ingesti   | ion: All Sou   | rces (mL/kg-c  | lay)            |                |
|--|--|---------------------|---------------|----------------|----------------|--|-----------------|----------------|----------------|-----------------|----------------|
|  |  |                     |               | Mean           |                | 6  | 90th percentile | e              | 6              | 95th percentile | 0              |
| \<br>\   |  | Sample              |               | %06            | C.I.           | •  | %06             | B.I.           |                | %06             | B.I.           |
| Age  |  | size                | Estimate      | Lower<br>Bound | Upper<br>Bound | Estimate   | Lower<br>Bound  | Upper<br>Bound | Estimate       | Lower<br>Bound  | Upper<br>Bound |
| Birth to <1 month                                      | nonth  | 88                  | 68            | 49             | 114            | 235*   | *861            | 269*           | *692           | 236*            | 332*           |
| 1 to <3 mont   | hs   | 245                 | 77            | 62             | 91             | 173  | 164             | 217            | 246*           | 187*            | 295*           |
| 3 to <6 months   | hs   | 411                 | 75            | 89             | 82             | 156  | 145             | 162            | 186            | 176             | 199            |
| 6 to <12 months  | ıths   | 829                 | 59            | 54             | 63             | 118  | 112             | 128            | 148            | 134             | 166            |
| 1 to <2 years  |  | 1,002               | 31            | 29             | 32             | 63   | 59              | 89             | 85             | 73              | 95             |
| 2 to <3 years  |  | 994                 | 31            | 30             | 33             | 59   | 57              | 62             | 73             | 69              | 81             |
| 3 to <6 years  |  | 4,112               | 29            | 28             | 30             | 99   | 54              | 99             | 69             | 99              | 72             |
| 6 to <11 years   | Ş  | 1,553               | 21            | 20             | 22             | 39   | 36              | 41             | 50             | 47              | 52             |
| 11 to <16 years  | ars  | 975                 | 16            | 15             | 17             | 31   | 29              | 34             | 39             | 36              | 41             |
| 16 to <18 years  | ars  | 360                 | 15            | 13             | 16             | 28   | 27              | 32             | 37*            | 33*             | * 4            |
| 18 to <21 years  | ars  | 383                 | 16            | 14             | 17             | 32   | 29              | 35             | 41*            | 36*             | *44            |
| a Inc  | ludes all par                                | rticipants          | whether or 1  | not they inge  | sted any wa    | Includes all participants whether or not they ingested any water from the source during survey period                            | ource durin     | g survey peri  | od.            |                 |                |
| ng .   | Direct water de                              | etined as v         | vater ingeste | ed directly a  | s a beverage   | fined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or              | er detined a    | s water adde   | d in the prepa | ration of too   | od or          |
|  | beverages.                                   | •                   | •             | •              | •              | :  |                 | ,              |                |                 |                |
| * The  | e sample sız                                 | e does not          | t meet minii  | num require    | ments as de    | The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United       | "Third Kep      | ort on Nutrit  | ion Monitorin  | ig in the Uni   | ited           |
|  | states (LSRO, 1993)<br>= Confidence Interval | , 1995).<br>nterval |               |                |                |  |                 |                |                |                 |                |
|  | = Bootstrap Interval.                        | erval.              |               |                |                |  |                 |                |                |                 |                |
|  | i  |                     |               |                |                |  |                 |                |                |                 |                |
| Source: Kahn and Stralka, 2008 and supplementary data. | hn and Stral                                 | ka, 2008 s          | and supplem   | entary data.   |                |  |                 |                |                |                 |                |

Table 3-14. Consumers Only<sup>a</sup> Estimates of Combined Direct and Indirect<sup>b</sup> Water Ingestion: Community Water (mL/day)

|                   |        |        |     | ( ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' |      |             |       |        |        |
|-------------------|--------|--------|-----|---|------|-------------|-------|--------|--------|
| <b>A</b>          | Sample | M      |     |   |      | Percentiles | 1     |        |        |
| Age               | size   | Mean - | 10  | 25                                      | 50   | 75          | 90    | 95     | 99     |
| Birth to <1 month | 40     | 470*   | 32* | 215*                                    | 482* | 692*        | 849*  | 858*   | 919*   |
| 1 to <3 months    | 114    | 552    | 67* | 339                                     | 533  | 801         | 943*  | 1,053* | 1,264* |
| 3 to <6 months    | 281    | 556    | 44  | 180                                     | 561  | 837         | 1,021 | 1,171* | 1,440* |
| 6 to <12 months   | 562    | 467    | 44  | 105                                     | 426  | 710         | 971   | 1,147  | 1,586* |
| 1 to <2 years     | 916    | 308    | 43  | 107                                     | 229  | 428         | 674   | 893    | 1,248* |
| 2 to <3 years     | 934    | 356    | 49  | 126                                     | 281  | 510         | 700   | 912    | 1,388* |
| 3 to <6 years     | 3,960  | 417    | 57  | 146                                     | 336  | 581         | 867   | 1,099  | 1,684  |
| 6 to <11 years    | 1,555  | 480    | 74  | 177                                     | 373  | 682         | 994   | 1,251  | 2,024* |
| 11 to <16 years   | 937    | 652    | 106 | 236                                     | 487  | 873         | 1,432 | 1,744  | 2,589* |
| 16 to <18 years   | 341    | 792    | 106 | 266                                     | 591  | 987         | 1,647 | 2,002* | 3,804* |
| 18 to <21 years   | 364    | 895    | 114 | 295                                     | 674  | 1,174       | 1,860 | 2,565* | 3,917* |

Excludes individuals who did not ingest water from the source during the survey period.

Source: Kahn and Stralka, 2008 and supplementary data.

Table 3-15. Consumers Only<sup>a</sup> Estimates of Combined Direct and Indirect<sup>b</sup> Water Ingestion: Bottled Water (mL/day) Percentiles Sample Age Mean size 10 25 75 90 95 99 50 Birth to <1 month 25 31\* 1 to <3 months 64 450\* 62\* 329\* 743\* 886\* 1,045\* 1,562\* 3 to <6 months 103 507 48\* 88 493 747 1,041\* 1,436\* 1,506\* 6 to <12 months 200 945\* 1,103\* 1,413\* 425 47 114 353 630 1 to <2 years 229 709\* 1,083\* 262 45 88 188 324 600 2 to <3 years 232 352 57 241 471 736 977\* 1,665\* 3 to <6 years 1,021 380 72 149 291 502 796 958 1,635\* 6 to <11 years 332 430 88 168 350 557 850 1,081\* 1,823\* 11 to <16 years 192 570 116\* 229 414 719 1,162\* 1,447\* 2,705\* 779\* 16 to <18 years 63 615\* 85\* 198\* 446\* 1,365\* 1,613\* 2,639\* 18 to <21 years 97 769 118\* 236 439 943 1,788\* 2,343\* 3,957\*

b Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

<sup>&</sup>lt;sup>a</sup> Excludes individuals who did not ingest water from the source during the survey period.

b Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>-</sup> Insufficient sample size to estimate mean and percentiles.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

18 to <21 years

Table 3-16. Consumers Only<sup>a</sup> Estimates of Combined Direct and Indirect<sup>b</sup> Water Ingestion: Other Sources (mL/day) Percentiles Sample Mean Age size 10 25 50 90 95 75 Birth to <1 month 3 1 to <3 months 19 3 to <6 months 59\* 38 562\* 179\* 412\* 739\* 983\* 1,205\* 2,264\* 6 to <12 months 73 407\* 31\* 121\* 300\* 563\* 961\* 1,032\* 1,144\* 1 to <2 years 98 18\* 143 371 602\* 899\* 1,204\* 262 65 2 to <3 years 129 354 56\* 134 318 472 704\* 851\* 1,334\* 3 to <6 years 533 396 59 148 314 796 1,019 1,543\* 546 6 to <11 years 219 448 89 177 347 682 931 1,090\* 1,596\* 11 to <16 years 151 2,891\* 687 171\* 296 482 947 1,356\* 1,839\* 16 to <18 years 53 657\* 152\* 231\* 398\* 823\* 1,628\* 1,887\* 2,635\*

142\*

371\*

806\*

1,160\*

1,959\*

1,962\*

569\*

Source: Kahn and Stralka, 2008 and supplementary data.

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| Table 3-17. Consu | ımers Only <sup>a</sup> l | Estimates of | of Combin | ed Direct a | nd Indirect <sup>t</sup> | Water Ingo  | estion: All | Sources (m | nL/day) |
|-------------------|---------------------------|--------------|-----------|-------------|--------------------------|-------------|-------------|------------|---------|
| A                 | Sample                    | Mana         |           |             |                          | Percentiles |             |            |         |
| Age               | size                      | Mean -       | 10        | 25          | 50                       | 75          | 90          | 95         | 99      |
| Birth to <1 month | 58                        | 511*         | 51*       | 266*        | 520*                     | 713*        | 858*        | 986*       | 1,274*  |
| 1 to <3 months    | 178                       | 555          | 68*       | 275         | 545                      | 801         | 946*        | 1,072*     | 1,470*  |
| 3 to <6 months    | 363                       | 629          | 69        | 384         | 612                      | 851         | 1,064       | 1,330*     | 1,522*  |
| 6 to <12 months   | 667                       | 567          | 90        | 250         | 551                      | 784         | 1,050       | 1,303      | 1,692*  |
| 1 to <2 years     | 1,017                     | 366          | 84        | 159         | 294                      | 481         | 735         | 978        | 1,281*  |
| 2 to <3 years     | 1,051                     | 439          | 105       | 213         | 375                      | 589         | 825         | 1,001      | 1,663*  |
| 3 to <6 years     | 4,350                     | 518          | 134       | 255         | 442                      | 682         | 980         | 1,206      | 1,796   |
| 6 to <11 years    | 1,659                     | 603          | 177       | 310         | 506                      | 805         | 1,131       | 1,409      | 2,168*  |
| 11 to <16 years   | 1,000                     | 837          | 229       | 404         | 665                      | 1,105       | 1,649       | 1,961      | 3,184*  |
| 16 to <18 years   | 357                       | 983          | 252       | 395         | 754                      | 1,276       | 1,865       | 2,346*     | 3,866*  |
| 18 to <21 years   | 383                       | 1,094        | 219       | 424         | 823                      | 1,397       | 2,144       | 3,002*     | 4,967*  |

Excludes individuals who did not ingest water from the source during the survey period.

<sup>103\*</sup> Excludes individuals who did not ingest water from the source during the survey period.

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

Insufficient sample size to estimate means and percentiles.

The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).



|                 | Table 3-                       | 18. Consu   | mers Only <sup>a</sup> E | stimates of   | Combined D   | Table 3-18. Consumers Only <sup>a</sup> Estimates of Combined Direct and Indirect <sup>b</sup> Water Ingestion: All Sources (mL/day) | irect <sup>b</sup> Water | Ingestion: 7   | All Sources (n | nL/day)         |        |
|-----------------|--------------------------------|-------------|--------------------------|---------------|--------------|--|--------------------------|----------------|----------------|-----------------|--------|
|                 |                                |             |                          | Mean          |              | 16   | 90th percentile          | e              | 36             | 95th percentile | )      |
|                 | ДОР                            | Sample      | 1                        | %06           | C.I.         |  | %06                      | B.I.           | •              | %06             | B.I.   |
|                 | 285                            | size        | Estimate                 | Lower         | Upper        | Estimate   | Lower                    | Upper          | Estimate       | Lower           | Upper  |
| Birth to        | Birth to <1 month              | 58          | 511*                     | 417*          | *909         | *858   | *958                     | *866           | *986           | 974*            | 1,076* |
| 1 to <3 months  | nonths                         | 178         | 555                      | 487           | 622          | 946*   | 891*                     | 1,042*         | 1,072*         | 1,022*          | 1,183* |
| 3 to <6 months  | nonths                         | 363         | 629                      | 587           | 672          | 1,064  | 1,011                    | 1,177          | 1,330*         | 1,183*          | 1,431* |
| 6 to <12 months | months                         | <i>L</i> 99 | 267                      | 534           | 009          | 1,050  | 1,001                    | 1,141          | 1,303          | 1,181           | 1,372  |
| 1 to <2 years   | /ears                          | 1,017       | 366                      | 346           | 385          | 735  | 715                      | 765            | 826            | 915             | 1,001  |
| 2 to <3 years   | /ears                          | 1,051       | 439                      | 420           | 457          | 825  | 784                      | 857            | 1,001          | 944             | 1,075  |
| 3 to <6 years   | /ears                          | 4,350       | 518                      | 466           | 537          | 086  | 961                      | 1,000          | 1,206          | 1,171           | 1,253  |
| 6 to <11 years  | years                          | 1,659       | 603                      | 574           | 632          | 1,131  | 1,075                    | 1,162          | 1,409          | 1,336           | 1,468  |
| 11 to <16 years | 6 years                        | 1,000       | 837                      | 773           | 901          | 1,649  | 1,568                    | 1,749          | 1,961          | 1,873           | 2,104  |
| 16 to <18 years | 8 years                        | 357         | 983                      | 968           | 1,071        | 1,865  | 1,774                    | 1,982          | 2,346*         | 2,129*          | 2,599* |
| 18 to <21 years | 1 years                        | 383         | 1,094                    | 666           | 1,189        | 2,144  | 1,951                    | 2,299          | 3,002*         | 2,576*          | 3,785* |
| а               | Excludes indiv                 | ividuals wh | o did not ing            | gest water fr | om the sourc | iduals who did not ingest water from the source during the survey period   | survey peric             | d.             |                |                 |        |
| Ф               | Direct water                   | defined as  | water ingeste            | ed directly a | s a beverage | Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or   | er defined a             | s water adde   | d in the prepa | ration of foc   | od or  |
|                 | beverages.                     |             |                          |               |              |  |                          |                |                |                 |        |
| *               | The sample s                   | ize does no | t meet minir             | num require   | ments as des | The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United           | "Third Rep               | ort on Nutriti | ion Monitorin  | g in the Uni    | ted    |
|                 | States" (LSRO, 1995).          | 0, 1995).   |                          |               |              |  |                          |                |                |                 |        |
| CI              | = Confidence                   | : Interval. |                          |               |              |  |                          |                |                |                 |        |
| BI              | = Bootstrap Interval.          | Interval.   |                          |               |              |  |                          |                |                |                 |        |
| Source:         | Source: Kahn and Stralka, 2008 | alka, 2008  |                          |               |              |  |                          |                |                |                 |        |

| <b>A</b>          | Sample | M    |     |     |      | Percentile | 3    |      |      |
|-------------------|--------|------|-----|-----|------|------------|------|------|------|
| Age               | size   | Mean | 10  | 25  | 50   | 75         | 90   | 95   | 99   |
| Birth to <1 month | 37     | 137* | 11* | 65* | 138* | 197*       | 235* | 238* | 263* |
| 1 to <3 months    | 108    | 119  | 12* | 71  | 107  | 151        | 228* | 285* | 345* |
| 3 to <6 months    | 269    | 80   | 7   | 27  | 77   | 118        | 148  | 173* | 222* |
| 6 to <12 months   | 534    | 53   | 5   | 12  | 47   | 81         | 112  | 129  | 186* |
| 1 to <2 years     | 880    | 27   | 4   | 9   | 20   | 36         | 56   | 75   | 109* |
| 2 to <3 years     | 879    | 26   | 4   | 9   | 21   | 36         | 52   | 62   | 121* |
| 3 to <6 years     | 3,703  | 24   | 3   | 8   | 19   | 33         | 49   | 65   | 97   |
| 6 to <11 years    | 1,439  | 17   | 3   | 6   | 13   | 23         | 35   | 45   | 72*  |
| 11 to <16 years   | 911    | 13   | 2   | 5   | 10   | 17         | 26   | 34   | 54*  |
| 16 to <18 years   | 339    | 12   | 1   | 4   | 9    | 16         | 24   | 32*  | 58*  |
| 18 to <21 years   | 361    | 13   | 2   | 5   | 10   | 17         | 29   | 35*  | 63*  |

Excludes individuals who did not ingest water from the source during the survey period.

Source Kahn and Stralka, 2008 and supplementary data.

| Λαο               | Sample | Mean - |    |     |     | Percentiles |      |      |      |
|-------------------|--------|--------|----|-----|-----|-------------|------|------|------|
| Age               | size   | Mean   | 10 | 25  | 50  | 75          | 90   | 95   | 99   |
| Birth to <1 month | 25     | -      | -  | -   | -   | -           | -    | -    | -    |
| 1 to <3 months    | 64     | 92*    | 7* | 12* | 76* | 151*        | 164* | 220* | 411* |
| 3 to <6 months    | 95     | 72     | 6* | 15  | 69  | 100         | 149* | 184* | 213* |
| 6 to <12 months   | 185    | 47     | 5* | 11  | 34  | 73          | 104* | 120* | 166* |
| 1 to <2 years     | 216    | 22     | 5  | 8   | 16  | 27          | 49   | 66*  | 103* |
| 2 to <3 years     | 211    | 25     | 4  | 8   | 17  | 35          | 54   | 81*  | 91*  |
| 3 to <6 years     | 946    | 21     | 4  | 8   | 16  | 29          | 45   | 57   | 90*  |
| 6 to <11 years    | 295    | 15     | 3  | 5   | 11  | 19          | 30   | 42*  | 69*  |
| 11 to <16 years   | 180    | 11     | 2* | 4   | 8   | 14          | 24*  | 27*  | 44*  |
| 16 to <18 years   | 63     | 10*    | 1* | 3*  | 7*  | 11*         | 23*  | 27*  | 37*  |
| 18 to <21 years   | 93     | 11     | 2* | 3   | 6   | 14          | 27*  | 30*  | 54*  |

<sup>&</sup>lt;sup>a</sup> Excludes individuals who did not ingest water from the source during the survey period.

b Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>-</sup> Insufficient sample size to estimate means and percentiles.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).



| <b>A</b>          | Sample |      |     |     |     | Percentiles |      |      |      |
|-------------------|--------|------|-----|-----|-----|-------------|------|------|------|
| Age               | size   | Mean | 10  | 25  | 50  | 75          | 90   | 95   | 99   |
| Birth to <1 month | 3      | -    | -   | -   | -   | -           | -    | -    | -    |
| 1 to <3 months    | 19     | -    | -   | -   | -   | -           | -    | -    | -    |
| 3 to <6 months    | 38     | 80*  | 10* | 23* | 59* | 106*        | 170* | 200* | 246* |
| 6 to <12 months   | 68     | 44*  | 4*  | 10* | 33* | 65*         | 95*  | 106* | 147* |
| 1 to <2 years     | 95     | 23   | 1*  | 5   | 13  | 28          | 46*  | 84*  | 125* |
| 2 to <3 years     | 124    | 26   | 4*  | 10  | 21  | 34          | 55*  | 66*  | 114* |
| 3 to <6 years     | 505    | 22   | 3   | 8   | 17  | 30          | 46   | 56   | 79*  |
| 6 to <11 years    | 208    | 16   | 3   | 6   | 12  | 23          | 32   | 39*  | 62*  |
| 11 to <16 years   | 148    | 13   | 3*  | 6   | 9   | 18          | 27*  | 36*  | 56*  |
| 16 to <18 years   | 52     | 10*  | 2*  | 4*  | 7*  | 12*         | 24*  | 29*  | 43*  |
| 18 to <21 years   | 33     | 8*   | 1*  | 2*  | 6*  | 10*         | 16*  | 27*  | 31*  |

- Excludes individuals who did not ingest water from the source during the survey period.
- Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.
- Means insufficient sample size to estimate distribution percentiles.
- \* The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).

Source Kahn and Stralka, 2008 and supplementary data.

| A                 | Sample | M =    |     |     |      | Percentiles |      |      |      |
|-------------------|--------|--------|-----|-----|------|-------------|------|------|------|
| Age               | size   | Mean - | 10  | 25  | 50   | 75          | 90   | 95   | 99   |
| Birth to <1 month | 55     | 153*   | 13* | 83* | 142* | 208*        | 269* | 273* | 400* |
| 1 to <3 months    | 172    | 116    | 12* | 50  | 107  | 161         | 216* | 291* | 361* |
| 3 to <6 months    | 346    | 90     | 9   | 52  | 86   | 125         | 161  | 195* | 233* |
| 6 to <12 months   | 631    | 63     | 10  | 27  | 58   | 88          | 120  | 152  | 198* |
| 1 to <2 years     | 980    | 31     | 7   | 14  | 25   | 40          | 64   | 86   | 122* |
| 2 to <3 years     | 989    | 31     | 7   | 15  | 27   | 41          | 59   | 73   | 130* |
| 3 to <6 years     | 4,072  | 29     | 7   | 15  | 25   | 38          | 56   | 70   | 102* |
| 6 to <11 years    | 1,542  | 21     | 6   | 10  | 18   | 27          | 39   | 50   | 76*  |
| 11 to <16 years   | 970    | 16     | 4   | 8   | 13   | 20          | 31   | 39   | 60*  |
| 16 to <18 years   | 354    | 15     | 4   | 7   | 12   | 18          | 29   | 37*  | 60*  |
| 18 to <21 years   | 378    | 16     | 3   | 6   | 12   | 21          | 32   | 41*  | 73*  |

<sup>&</sup>lt;sup>a</sup> Excludes individuals who did not ingest water from the source during the survey period.

Direct water defined as water ingested directly as a beverage; indirect water defined as water added in the preparation of food or beverages.

<sup>\*</sup> The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United States" (LSRO, 1995).



|                 |                                   | Table 3-23.  | Consumer                       | $Only^a$ Estim | ates of Total  | able 3-23. Consumer Only <sup>a</sup> Estimates of Total Direct and Indirect <sup>o</sup> Water Ingestion (mL/kg-day)   | ndirect <sup>o</sup> Wat | er Ingestion        | (mL/kg-day)  |                 |                |
|-----------------|-----------------------------------|--|--------------------------------|----------------|----------------|---|--------------------------|---------------------|--|-----------------|----------------|
|                 |                                   |  |                                | Mean           |                | 6   | 90th percentile          | a                   | \$6  | 95th percentile |                |
|                 | ,                                 | Sample   |                                | 90% C.I.       | C.I.           |   | 90% B.I.                 | B.I.                |  | 90% B.I         | B.I.           |
|                 | Age                               | size   | Estimate                       | Lower<br>Bound | Upper<br>Bound | Estimate  | Lower<br>Bound           | Upper<br>Bound      | Estimate   | Lower<br>Bound  | Upper<br>Bound |
| Birth to        | Birth to <1 month                 | 55   | 153*                           | 125*           | 181*           | *692  | 234*                     | 273*                | 273*   | 263*            | 332*           |
| 1 to <3 months  | nonths                            | 172  | 116                            | 100            | 132            | 216*  | 176*                     | 259*                | 291*   | 214*            | 316*           |
| 3 to <6 months  | nonths                            | 346  | 06                             | 83             | 26             | 161   | 145                      | 178                 | 195*   | 174*            | 212*           |
| 6 to <12 months | months                            | 631  | 63                             | 59             | 29             | 120   | 117                      | 127                 | 152  | 137             | 166            |
| 1 to <2 years   | ears                              | 086  | 31                             | 30             | 33             | 49  | 57                       | <i>L</i> 9          | 98   | 70              | 68             |
| 2 to <3 years   | ears                              | 686  | 31                             | 30             | 33             | 59  | 99                       | 61                  | 73   | <i>L</i> 9      | 81             |
| 3 to <6 years   | ears                              | 4,072  | 29                             | 28             | 30             | 99  | 54                       | 57                  | 70   | <i>L</i> 9      | 73             |
| 6 to <11 years  | years                             | 1,542  | 21                             | 20             | 22             | 39  | 37                       | 41                  | 50   | 46              | 52             |
| 11 to <16 years | 5 years                           | 026  | 16                             | 15             | 17             | 31  | 29                       | 33                  | 39   | 38              | 42             |
| 16 to <18 years | 3 years                           | 354  | 15                             | 14             | 16             | 29  | 27                       | 32                  | 37*  | 33v             | *              |
| 18 to <21 years | l years                           | 378  | 16                             | 15             | 18             | 32  | 29                       | 35                  | 41*  | 36*             | <sub>*95</sub> |
| a<br>b          | Excludes indiv                    | dividuals wh   | o did not ing<br>vater ingeste | gest water fr  | om the sourc   | Excludes individuals who did not ingest water from the source during the survey period Direct water defined as water incested directly as a beverage; indirect water defined as | survey peric             | d.<br>s water adder | viduals who did not ingest water from the source during the survey period.<br>Jefined as water inoested directly as a beverage indirect water defined as water added in the preparation of food or | ration of foc   | d or           |
|                 | beverages.                        |  | 0                              |                |                |   |                          |                     |  |                 |                |
| *               | The sample                        | size does no   | t meet minin                   | num require    | ments as des   | scribed in the  | "Third Rep               | ort on Nutriti      | The sample size does not meet minimum requirements as described in the "Third Report on Nutrition Monitoring in the United   | g in the Uni    | ted            |
| 5               | States .<br>- Confidence Interval | Luterwal   |                                |                |                |   |                          |                     |  |                 |                |
| BI              | = Bootstrap Interval.             | Interval.  |                                |                |                |   |                          |                     |  |                 |                |
| Č               | -                                 | 9000   | -                              |                |                |   |                          |                     |  |                 |                |
| Source:         | Kahn and S                        | Source: Kahn and Stralka, 2008 and supplementary data. | and supplem                    | entary data.   |                |   |                          |                     |  |                 |                |



| Table 3   | able 3-24. Water Ingested (mL/day) <sup>a</sup> from Water By Itself and Water Added to Other Beverages and Foods  | from Water By Itself an  | d Water Added to Other I          | Severages and Foods                |                                    |
|---|--|--|-----------------------------------|------------------------------------|------------------------------------|
| Category  |  | 6  Weeks $(N = 124)$   | 3 Months $(N = 120)$              | 6 Months $(N = 99)$                | 9 Months $(N = 77)$                |
| Water by Itself   | Range<br>Per capita mean <sup>b</sup> ± SD<br>Consumer only mean <sup>c</sup><br>Percent consuming <sup>d</sup>  | 0-355<br>$30 \pm 89$<br>89<br>28                                   | 0.355<br>$30 \pm 59$<br>89<br>24  | 0.266<br>$30 \pm 59$<br>118<br>42  | $0.473 \\ 89 \pm 89 \\ 118 \\ 66$  |
| Water Added to Formula<br>Powdered Concentrate  | Range<br>Per capita mean ± SD<br>Consumer only mean<br>Percent consuming   | 0-1,242<br>177 ± 296<br>473<br>39                                  | 0-1,242<br>266 ± 384<br>621<br>42 | 0-1,124<br>266 ± 355<br>562<br>48  | 0-1,064<br>207 ± 325<br>562<br>36  |
| Liquid Concentrate  | Range<br>Per capita mean ± SD<br>Consumer only mean<br>Percent consuming   | 0-621<br>89±148<br>355<br>23                                       | $0-680$ $237 \pm 207$ $384$       | $0.710$ $148 \pm 207$ $414$ $35$   | 0-532<br>59±148<br>325<br>21       |
| All Concentrated Formula  | Range<br>Per capita mean ± SD<br>Consumer only mean<br>Percent consuming   | 0-1,242<br>266 ± 296<br>444<br>60                                  | 0-1,242<br>384 ± 355<br>562<br>68 | $0-1,123$ $414 \pm 325$ $532$ $81$ | 0-1,064<br>266 ± 296<br>503<br>56  |
| Water Added to Juices<br>and Other Beverages  | Range<br>Per capita mean ± SD<br>Consumer only mean<br>Percent consuming   | 0.118<br>$<30 \pm 30$<br>89<br>3                                   | 0.710<br>$30 \pm 89$<br>207<br>9  | 0-473<br>$30 \pm 89$<br>148<br>18  | $0-887$ $59 \pm 148$ $207$ $32$    |
| Water Added to Powdered<br>Baby Foods and Cereals   | Range<br>Per capita mean ± SD<br>Consumer only mean<br>Percent consuming   | $0.30$ $<30 \pm 30$ $30$ $2$                                       | 0.177<br>$<30 \pm 30$<br>59<br>17 | 0-266<br>59±59<br>89<br>64         | 0-177<br>30 ± 59<br>89<br>43       |
| Water Added to Other Foods<br>(Soups, Jell-o, Puddings)   | Range<br>Per capita mean ± SD<br>Consumer only mean<br>Percent consuming   | 0  | 0.118<br>$30 \pm 30$<br>89<br>2   | $0.118$ $<30 \pm 30$ $59$ 8        | 0.355<br>$30 \pm 59$<br>118<br>29  |
| ALL SOURCES OF WATER  | Range Per capita mean ± SD Consumer only mean Percent consuming  | $\begin{array}{c} 0-1,242 \\ 296 \pm 325 \\ 414 \\ 68 \end{array}$ | 0-1,419<br>414 ± 414<br>562<br>77 | $0-1,123$ $473 \pm 325$ $503$ $94$ | $0-1,745$ $444 \pm 355$ $473$ $97$ |
| Converted from ounces/day; 1 fluid  Mean intake among entire sample.  Mean intake for only those ingestin  Percentage of infants receiving wat  N = Number of observations.  SD = Standard Deviation. | Converted from ounces/day; 1 fluid ounce = 29.57 mL.  Mean intake among entire sample.  Mean intake for only those ingesting water from the particular category.  Percentage of infants receiving water from that individual source.  = Number of observations.  = Standard Deviation. | ticular category.<br>ial source.                                   |                                   |                                    |                                    |
| Source: Levy et al., 1995.  |  |  |                                   |                                    |                                    |



|                        |   |                             |   | Table 3-25. 1              | Table 3-25. Mean Water Consumption (mL/kg-day) by Race/Ethnicity   | sumption (mL   | /kg-day) b   | y Race/Ethnicity                   | ,                            |          |            |
|------------------------|---|-----------------------------|---|----------------------------|--|----------------|--------------|------------------------------------|------------------------------|----------|------------|
| Race/Ethnic<br>Group   |   | z                           | Plain<br>Tap Water  | Milk and<br>Milk<br>Drinks | Reconstitute<br>d Formula  | RTF<br>Formula | Baby<br>Food | Juices and<br>Carbonated<br>Drinks | Non-<br>carbonated<br>Drinks | Other    | Totalª     |
| Black non-<br>Hispanic |   | 121                         | 21 (1.7)  | 24<br>(4.6)                | 35 (6.0)   | 4 (2.0)        | 8 (1.6)      | 2<br>(0.7)                         | 14 (1.3)                     | 21 (1.7) | 129 (5.7)  |
| White non-<br>Hispanic |   | 620                         | 13 (0.8)  | 23 (1.2)                   | 29 (2.7)   | 8 (1.5)        | 10 (1.2)     | 1 (0.2)                            | 11 (0.7)                     | 18 (0.8) | 113 (2.6)  |
| Hispanic               |   | 146                         | 15 (1.2)  | 23 (2.4)                   | 38 (7.3)   | 12 (4.0)       | 10 (1.4)     | 1 (0.3)                            | 10 (1.6)                     | 16 (1.4) | 123 (5.2)  |
| Other                  | 5   | 59                          | 21 (2.4)  | 19 (3.7)                   | 31 (9.1)   | 19 (11.2)      | 7 (4.0)      | 1 (0.5)                            | 8 (2.0)                      | 19 (3.2) | 124 (10.6) |
| a<br>N<br>RTF<br>Note: | Totals may be slig<br>= Number of obse<br>= Ready-to-Feed.<br>Standard Error sh | ay be ar of ol to-Fee Error | Totals may be slightly different from = Number of observations. = Ready-to-Feed. Standard Error shown in parentheses. | ent from the s             | Totals may be slightly different from the sums of all categories due to rounding.  = Number of observations.  = Ready-to-Feed.  Standard Error shown in parentheses. | ries due to ro | unding.      |                                    |                              |          |            |
| Source:                | Source: Heller et al., 2000   | al., 20                     | .00   |                            |  |                |              |                                    |                              |          |            |



|                               |     | Plain Ta<br>(mL/k |     |      | Water<br>g-day) |
|-------------------------------|-----|-------------------|-----|------|-----------------|
| Variable                      | N   | Mean              | SE  | Mean | SE              |
| Age                           |     |                   |     |      |                 |
| <12 months                    | 296 | 11                | 1.0 | 130  | 4.6             |
| 12-24 months                  | 650 | 18                | 0.8 | 108  | 1.7             |
| Sex                           |     |                   |     |      |                 |
| Male                          | 475 | 15                | 1.0 | 116  | 4.1             |
| Female                        | 471 | 15                | 0.8 | 119  | 3.2             |
| Region                        |     |                   |     |      |                 |
| Northeast                     | 175 | 13                | 1.4 | 121  | 6.3             |
| Midwest                       | 197 | 14                | 1.0 | 120  | 3.1             |
| South                         | 352 | 15                | 1.3 | 113  | 3.7             |
| West                          | 222 | 17                | 1.1 | 119  | 4.6             |
| Urbanicity                    |     |                   |     |      |                 |
| Urban                         | 305 | 16                | 1.5 | 123  | 3.5             |
| Suburban                      | 446 | 13                | 0.9 | 117  | 3.1             |
| Rural                         | 195 | 15                | 1.2 | 109  | 3.9             |
| Poverty category <sup>a</sup> |     |                   |     |      |                 |
| 0-1.30                        | 289 | 19                | 1.5 | 128  | 2.6             |
| 1.31-3.50                     | 424 | 14                | 1.0 | 117  | 4.2             |
| >3.50                         | 233 | 12                | 1.3 | 109  | 3.5             |
| Total                         | 946 | 15                | 0.6 | 118  | 2.3             |

<sup>&</sup>lt;sup>a</sup> Poverty category represents family's annual incomes of 0-1.30, 1.31-3.50, and greater than 3.50 times the federal poverty level.

Source: Heller et al., 2000.

N = Number of observations.

SE = Standard Error.



| Table 3-27. Ilitake                             |   | us Sources in 2-13-y-0<br>Study 1985-1999             | nd I articipants of th                     | C   |
|---|---|---|--|---|
| Water Intake from:                              | Boys and girls<br>2-3 years<br>N = 858 <sup>b</sup> | Boys and girls<br>4-8 years<br>N = 1,795 <sup>b</sup> | Boys<br>9-13 years<br>N = 541 <sup>b</sup> | Girls<br>9-13 years<br>N = 542 <sup>b</sup> |
|   |   | Me  | an   |   |
| Water in Food (mL/day) <sup>a</sup>             | 365 (33) <sup>c</sup>                               | 487 (36)  | 673 (36)                                   | 634 (38)                                    |
| Beverages (mL/day) <sup>a</sup>                 | 614 (55)  | 693 (51)  | 969 (51)                                   | 823 (49)                                    |
| Milk (mL/day) <sup>a</sup>                      | 191 (17)  | 177 (13)  | 203 (11)                                   | 144 (9)                                     |
| Mineral water (mL/day) <sup>a</sup>             | 130 (12)  | 179 (13)  | 282 (15)                                   | 242 (15)                                    |
| Tap water (mL/day) <sup>a</sup>                 | 45 (4)  | 36 (3)  | 62 (3)                                     | 56 (3)                                      |
| Juice (mL/day) <sup>a</sup>                     | 114 (10)  | 122 (0)   | 133 (7)                                    | 138 (8)                                     |
| Soft drinks (mL/day) <sup>a</sup>               | 57 (5)  | 111 (8)   | 203 (11)                                   | 155 (9)                                     |
| Coffee/tea (mL/day) <sup>a</sup>                | 77 (7)  | 69 (5)  | 87 (4)                                     | 87 (5)                                      |
|   |   | Mean  | ± SD                                       |   |
| Total water intake <sup>a,d</sup> (mL/day)      | $1,114 \pm 289$                                     | $1,363 \pm 333$                                       | $1,891 \pm 428$                            | $1,676 \pm 386$                             |
| Total water intake <sup>a,d</sup> (mL/kg-day)   | $78 \pm 22$   | 61 ± 13   | 49 ± 11                                    | $43 \pm 10$                                 |
| Total water intake <sup>a,d</sup> (mL/kcal-day) | $1.1\pm0.3$   | $0.9\pm0.2$   | $1.0\pm0.2$                                | $1.0 \pm 0.2$                               |

<sup>&</sup>lt;sup>a</sup> Converted from g/day, g/kg-day, or g/kcal-day; 1 g = 1 mL.

Source: Sichert-Hellert et al., 2001.

N = Number of records.

<sup>&</sup>lt;sup>c</sup> Percent of total water shown in parentheses.

Total water = water in food + beverages + oxidation.

SD = Standard deviation.

| Table 3-28. Mean (± Standard Error) Fluid Intake (mL/kg/day) by Children Aged 1-10 years, |  |
|---|--|
| NHANES III, 1988-94   |  |

|                   | Total Sample (N = 7,925) | Sample with Temperature Information $(N = 3,869)$ | Sample without Temperature Information $(N = 4,056)$ |
|-------------------|--------------------------|---|--|
| Total fluid       | $84 \pm 1.0$             | 84 ± 1.0  | $85 \pm 1.4$   |
| Plain water       | $27 \pm 0.8$             | $27\pm1.0$  | $26 \pm 1.1$   |
| Milk              | $18 \pm 0.3$             | $18 \pm 0.6$                                      | $18 \pm 0.4$   |
| Carbonated drinks | $6 \pm 0.2$              | $5 \pm 0.3$                                       | $6 \pm 0.3$  |
| Juice             | $12 \pm 0.3$             | $11 \pm 0.6$                                      | $12 \pm 0.4$   |

N = Number of observations.

Source: Sohn et al., 2001.

Table 3-29. Estimated Mean (± Standard Error) Amount of Total Fluid and Plain Water Intake among Children<sup>a</sup> Aged 1-10 Years: (NHANES III, 1988-94)

|                                   | N.T.  | Total           | Fluid         | Plain         | Water        |
|-----------------------------------|-------|-----------------|---------------|---------------|--------------|
|                                   | N -   | mL/day          | mL/kg-day     | mL/day        | mL/kg-day    |
| Age (years)                       |       |                 |               |               |              |
| 1                                 | 578   | $1,393 \pm 31$  | $124 \pm 2.9$ | $298 \pm 19$  | $26 \pm 1.8$ |
| 2                                 | 579   | $1,446 \pm 31$  | $107 \pm 2.3$ | $430 \pm 26$  | $32 \pm 1.9$ |
| 3                                 | 502   | $1,548 \pm 75$  | $100 \pm 4.6$ | $482.\pm\ 27$ | $31 \pm 1.8$ |
| 4                                 | 511   | $1,601 \pm 41$  | $91 \pm 2.8$  | $517 \pm 23$  | $29 \pm 1.3$ |
| 5                                 | 465   | $1,670 \pm 54$  | $84 \pm 2.3$  | $525 \pm 36$  | $26 \pm 1.7$ |
| 6                                 | 255   | $1,855 \pm 125$ | $81 \pm 4.9$  | $718 \pm 118$ | $31 \pm 4.7$ |
| 7                                 | 235   | $1,808 \pm 66$  | $71 \pm 2.3$  | $674 \pm 46$  | $26 \pm 1.9$ |
| 8                                 | 247   | $1,792 \pm 37$  | $61 \pm 1.8$  | $626 \pm 37$  | $21 \pm 1.2$ |
| 9                                 | 254   | $2,113 \pm 78$  | $65 \pm 2.1$  | $878 \pm 59$  | $26 \pm 1.4$ |
| 10                                | 243   | $2,051 \pm 97$  | $58 \pm 2.4$  | $867 \pm 74$  | $24 \pm 2.0$ |
| Sex                               |       |                 |               |               |              |
| Male                              | 1,974 | $1,802 \pm 30$  | $86 \pm 1.8$  | $636 \pm 32$  | $29 \pm 1.3$ |
| Female                            | 1,895 | $1,664 \pm 24$  | $81 \pm 1.5$  | $579 \pm 26$  | $26 \pm 1.0$ |
| Race/ethnicity                    |       |                 |               |               |              |
| White                             | 736   | $1,653 \pm 26$  | $79 \pm 1.8$  | $552 \pm 34$  | $24 \pm 1.3$ |
| African American                  | 1,122 | $1,859 \pm 42$  | $88 \pm 1.8$  | $795 \pm 36$  | $36 \pm 1.5$ |
| Mexican American                  | 1,728 | $1,817 \pm 25$  | $89 \pm 1.7$  | $633 \pm 23$  | $29 \pm 1.1$ |
| Other                             | 283   | $1,813 \pm 47$  | $90 \pm 4.2$  | $565 \pm 39$  | $26 \pm 1.7$ |
| Poverty income ratio <sup>b</sup> |       |                 |               |               |              |
| Low                               | 1,868 | $1,828 \pm 32$  | $93 \pm 2.6$  | $662 \pm 27$  | $32 \pm 1.3$ |
| Medium                            | 1,204 | $1,690 \pm 31$  | $80 \pm 1.6$  | $604 \pm 35$  | $26 \pm 1.4$ |
| High                              | 379   | $1,668 \pm 54$  | $76 \pm 2.5$  | $533 \pm 41$  | $22 \pm 1.7$ |
| Region <sup>c,d</sup>             |       |                 |               |               |              |
| Northeast                         | 679   | $1,735 \pm 31$  | $87 \pm 2.3$  | $568 \pm 52$  | $26 \pm 2.1$ |
| Midwest                           | 699   | $1,734 \pm 45$  | $84 \pm 1.5$  | $640 \pm 54$  | $29 \pm 1.8$ |
| South                             | 869   | $1,739 \pm 31$  | $83 \pm 2.2$  | $613 \pm 24$  | $28 \pm 1.3$ |
| West                              | 1,622 | $737 \pm 25$    | $81 \pm 1.7$  | $624 \pm 44$  | $27 \pm 1.9$ |
| Urban/rural <sup>d</sup>          | *     |                 |               |               |              |
| Urban                             | 3,358 | $1,736 \pm 18$  | $84 \pm 1.0$  | $609 \pm 29$  | $27 \pm 1.1$ |
| Rural                             | 511   | $1,737 \pm 19$  | $84 \pm 4.3$  | $608 \pm 20$  | $28 \pm 1.2$ |
| Total                             | 3,869 | $1,737 \pm 15$  | $84 \pm 1.1$  | $609 \pm 24$  | $27 \pm 1.0$ |

Children for whom temperature data were obtained.

Source: Sohn et al., 2001.

b Based on ratio of household income to federal poverty threshold. Low: ≤1.300; medium: 1.301-3.500; high ≥3.501.

All variables except for Region and Urban/rural showed statistically significant differences for both total fluid and plain water intake by Bonferroni multiple comparison method.

Northeast = Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont:

Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin;

South = Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia;

West = Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

N = Number of observations.





|  | Tal  | Table 3-30.   |   | ater Intake   | in Breas  | tfed and  | Formula                                       | fed Infa   | Tap Water Intake in Breastfed and Formula-fed Infants and Mixed-fed Young Children at Different Age Points | red-fed Y   | oung Cl                                | nildren               | at Differe                                | nt Age Po                          | oints     |           |                                 |                   |
|--|--|---|---|---|---|---|---|--|--|---|--|-----------------------|---|------------------------------------|-----------|-----------|---------------------------------|-------------------|
|  | •  | ,   | Tap wate  | Tap water intake <sup>b</sup> (mL/day)  | (mL/day)  |   |   |  |  | L   | ap wate                                | r intake <sup>]</sup> | Tap water intake <sup>b</sup> (mL/kg-day) | -day)                              |           |           |                                 |                   |
| Age  | Z  |   |   | Total   |   |   |   |  | Total  | _   |  |                       | From                                      | From Household $^{\circ}$          | .pi       | From M    | From Manufacturing <sup>d</sup> | ring <sup>d</sup> |
|  |  | Mean  | SD  | Median  | P95   | Max   | Mean  | SD   | Median   | P95   | Max                                    | °%                    | Mean                                      | SD                                 | у ф       | Mean      | SD                              | у%                |
| Breastfed  |  |   |   |   |   |   |   |  |  |   |  |                       |   |                                    |           |           |                                 |                   |
| ≤1 year, total   | 30   | 130   | 180   | 50  | 525   | 1,172   | 17  | 24**   | 9  | 65  | 150                                    | 17                    | 15  | 23**                               | 85        | 2.4       | 4.7**                           | 15                |
| 3 months   | 11   | 29  | 167   | 0   | 493   | 746   | 10  | 25**   | 0  | 74  | 125                                    | 10                    | 10  | 25**                               | 26        | 0.3       | 1.9**                           | 3                 |
| 6 months   | 12   | 136   | 150   | 89  | 479   | 634   | 18  | 20**   | 8  | 8.8   | 85                                     | 18                    | 14  | 19**                               | 62        | 3.8       | 6.3*                            | 21                |
| 9 months   | 47   | 254   | 218   | 207   | 929   | 1,172   | 30  | 27**   | 23   | 77  | 150                                    | 28                    | 26  | 27**                               | 87        | 3.7       | 3.4                             | 13                |
| 12 months  | 18   | 144   | 170   | 85  | 649   | 649   | 15  | 18**   | 6  | 99  | 99                                     | 19                    | 13  | 18**                               | 98        | 2.2       | 2.1                             | 14                |
| Formula fed  |  |   |   |   |   |   |   |  |  |   |  |                       |   |                                    |           |           |                                 |                   |
| ≤1 year, total   | 75   | 441   | 244   | 440   | 828   | 1,603   | 53  | 33   | 49   | 115   | 200                                    | 51                    | 49  | 33                                 | 92        | 4.0       | 8.0                             | ∞                 |
| 3 months   | 78   | 662   | 154   | 673   | 874   | 994   | 107   | 23   | 107  | 147   | 159                                    | 93                    | 103                                       | 28                                 | 26        | 3.4       | 17.9                            | ж                 |
| 6 months   | 14   | 500   | 178   | 519   | 757   | 888   | 63  | 23   | 65   | 66  | 109                                    | 64                    | 59  | 25                                 | 92        | 4.8       | 8.0                             | ∞                 |
| 9 months   | 24   | 434   | 236   | 406   | 839   | 1,579   | 49  | 27   | 45   | 94  | 200                                    | 50                    | 44  | 27                                 | 91        | 4.5       | 6.3                             | 6                 |
| 12 months  | 29   | 360   | 256   | 335   | 789   | 1,603   | 37  | 26   | 32   | 83  | 175                                    | 39                    | 33  | 25                                 | 91        | 3.3       | 3.7                             | 6                 |
| Mixed - Breast and Formula   | Formula  |   |   |   |   |   |   |  |  |   |  |                       |   |                                    |           |           |                                 |                   |
| 1-3 years, total   | 90   | 241   | 243   | 175   | 929   | 2,441   | 19  | 20   | 14   | 99  | 203                                    | 24                    | 15  | 20                                 | 78        | 3.9       | 5.5                             | 22                |
| 18 months  | 27   | 280   | 264   | 205   | 828   | 1,881   | 25  | 23   | 18   | 70  | 183                                    | 28                    | 22  | 23                                 | 88        | 3.0       | 4.1                             | 12                |
| 24 months  | 29   | 232   | 263   | 158   | 630   | 2,441   | 18  | 21   | 12   | 49  | 203                                    | 23                    | 15  | 21                                 | 80        | 3.7       | 5.0                             | 70                |
| 36 months  | 33   | 217   | 199   | 164   | 578   | 1,544   | 14  | 13   | 11   | 36  | 103                                    | 22                    | 6   | 12                                 | 99        | 4.9       | 9.9                             | 34                |
| Numbers of 3-day diet records.  Total tap water = tap water from the household and tap water from food manufacturing. Converted from g/day and g/kg-day; 1 g = 1 mL.  Total tap water = tap water from the household tap consumed directly as a beverage or used to prepare foods and beverages.  Tap water from household = tap water from the industrial food production used for the preparation of foods (bread, butter/margarine, tinned fruit, vegetables and legumes, ready to serve meals, commercial weaning food) and mixed beverages (lemonade, soft drinks).  Mean as a percentage of total water.  Mean as a percentage of total tap water.  Significantly different from formula-fed infants, p<0.0001.  Significantly different from formula-fed infants, p<0.0001.  SD = Standard Deviation.  P95 = 95 <sup>th</sup> percentile.  Source: Hilbig et al., 2002. | 3-day di<br>ater = taj<br>rom hous<br>rom hous<br>s, ready i<br>ercentage<br>ercentage<br>y differe<br>y differe<br>Deviatio<br>ntile. | et record  water fr chold = t  = manuf o = or total  t from fr n. from fc | s. om the l ap water acturing neals, co water. tap wate ormula-l ormula-f | nousehold<br>t from the<br>t tap water<br>mmercial<br>xr.<br>fed infants<br>ed infants. | and tap 1<br>househo<br>from the<br>weaning<br>, p<0.005. | water fro ld tap co ld tap co industri food) an food) an 1. | m food n<br>nsumed (<br>al food p<br>id mixed | nanufact<br>Jirectly a:<br>roduction<br>beverage | uring. Con's a beverag   | verted froe or usede or usede or usedance | om g/day<br>to prepration of<br>inks). | and g/k<br>foods (l   | g-day; 1<br>s and bev<br>oread, bui       | g = 1 mL<br>'erages.<br>tter/marg; | arine, ti | nned frui | t, vegetal                      | bles              |



| Tab  | de 3-31. Percen   | tage of Subjects Cor   | nsuming Beverages   | and Mean Daily Bev  | verage Intakes (mL/c  | Table 3-31. Percentage of Subjects Consuming Beverages and Mean Daily Beverage Intakes (mL/day) for Children With Returned Questionnaires   | th Returned Question             | naires                                |
|--|---|--|---|---|---|---|----------------------------------|---------------------------------------|
| Age at Questionnaire<br>Actual Age (Months)<br>N <sup>b</sup>                | nnaire<br>onths)  | 6 Months $6.29 \pm 0.35$ $677$   | 9 Months $9.28 \pm 0.35$ $681$  | 12 Months 12.36 $\pm$ 0.46 659  | 16 Months $16.31 \pm 0.49$ $641$  | 20 Months $20.46 \pm 0.57$ $632$  | 24 Months $24.41 \pm 0.53$ $605$ | 6-24 Months <sup>a</sup><br>-<br>585° |
| Human Milk <sup>d</sup>  |   | 30   | 19  | 11  | 5   | ю   | 0                                | •                                     |
| Infant Formula°<br>% <sup>d</sup><br>mL/day <sup>f</sup>                     |   | 68<br>798 ± 234  | 69<br>615 ± 328   | 29<br>160 ± 275   | 4<br>12 ± 77  | 2<br>9 ± 83   | 0 -                              | $67^{g}$ $207 \pm 112$                |
| Cows' Milk°<br>% <sup>d</sup><br>mL/day <sup>f</sup>                         |   | 5<br>30 ± 145  | 25<br>136 ± 278   | 79<br>470 ± 310   | 91<br>467 ± 251   | $93$ $402 \pm 237$  | $97$ $358 \pm 225$               | $67^{g}$ $355 \pm 163$                |
| Formula and Cows' Milk <sup>®</sup><br>% <sup>d</sup><br>mL/day <sup>f</sup> | ows' Milk <sup>e</sup>  | $70 \\ 828 \pm 186$  | 81<br>751 ± 213   | 88<br>630 ± 245   | 92<br>479 ± 248   | 94<br>411 ± 237   | 98<br>358 ± 228                  | $67^g$ $562 \pm 154$                  |
| Juice and Juice Drinks % <sup>d</sup> mL/day <sup>f</sup>                    | Drinks  | 55<br>65 ± 95  | 73<br>103 ± 112   | 89<br>169 ± 151   | 94<br>228 ± 166   | 95<br>269 ± 189   | 93<br>228 ± 172                  | 99 <sup>h</sup><br>183 ± 103          |
| Water<br>% <sup>d</sup><br>mL/day <sup>f</sup>                               |   | 36<br>27 ± 47  | 59<br>53±71   | 75<br>92 ± 109  | 87<br>124 ± 118   | 90<br>142 ± 127   | 94<br>145 ± 148                  | 99 <sup>h</sup><br>109 ± 74           |
| Other Beverages <sup>i</sup><br>% <sup>d</sup><br>mL/day <sup>f</sup>        | iss,  | 3 + 18   | 9<br>6±27   | 23<br>27 ± 71   | 42<br>53 ± 109  | 62<br>83 ±121   | 86<br>89±133                     | $80^{\rm h}$<br>$44 \pm 59$           |
| Total Beverages mL/day <sup>e,f,j</sup>                                      | s mL/day <sup>e,f,j</sup>   | $934\pm219$  | $917 \pm 245$   | $926\pm293$   | $887 \pm 310$   | $908 \pm 310$   | $819 \pm 299$                    | $920 \pm 207$                         |
| Cum b Num c Num d Perc e Chil f Mea g Perc h Perc i Othke                    | Cumulative number of Number of children w Number of children w Number of children w Percentage of children are not inclu Mean ± standard devig Percentage of children Percentage of children Percentage of children Other beverages inclu | Cumulative number of children and percentage of children Number of children with returned questionnaires at each tin Number of children with cumulative intakes for six-through Percentage of children consuming beverage.  Children are not included when consuming human milk.  Mean ± standard deviation of beverage intake. Converted Percentage of children consuming beverage during six-througher consuming beverage during six-througher beverages of children consuming beverages (e.g., carbona Total beverages include non juice beverages (e.g., carbona protein beverages includes all beverages except human milk. | Cumulative number of children and percentage of children consuming beverage and Number of children with returned questionnaires at each time period.  Number of children with cumulative intakes for six-through 24 month period.  Percentage of children consuming beverage.  Mean ± standard deviation of beverage intake. Converted from ounces/day; 1 fluid o Percentage of children consuming beverage during six-through 24 month period. Che Percentage of children consuming beverage during six-through 24 month period. Other beverages include non juice beverages (e.g., carbonated beverages, Kool-Aid). | consuming beverage to period.  24 month period. om ounces/day; 1 fl igh 24 month period ed beverages, Kool- | Cumulative number of children and percentage of children consuming beverage and beverage intakes f Number of children with returned questionnaires at each time period.  Number of children with cumulative intakes for six-through 24 month period.  Percentage of children consuming beverage.  Children are not included when consuming human milk.  Mean ± standard deviation of beverage intake. Converted from ounces/day; 1 fluid ounce = 29.57 mL. Percentage of children consuming beverage during six-through 24 month period. Children who consum Percentage of children consuming beverage during six-through 24 month period.  Other beverages include non juice beverages (e.g., carbonated beverages, Kool-Aid). | Cumulative number of children and percentage of children consuming beverage and beverage intakes for the 6 through 24 month period.  Number of children with returned questionnaires at each time period.  Number of children with cumulative intakes for six-through 24 month period.  Percentage of children consuming beverage.  Children are not included when consuming human milk.  Mean ± standard deviation of beverage intake. Converted from ounces/day; 1 fluid ounce = 29.57 mL.  Percentage of children consuming beverage during six-through 24 month period. Children who consumed human milk are not included. Percentage of children consuming beverage during six-through 24 month period.  Other beverages include non juice beverages (e.g., carbonated beverages, Kool-Aid). | 4 month period.                  |                                       |
| Source: Mars   | Marshall et al., 2003a  | la.  |   |   |   |   |                                  |                                       |





|                            |   |  |                                |                       |   |                           |           |                |                     |         |                |                     | ĺ    |
|----------------------------|---|--|--------------------------------|-----------------------|---|---------------------------|-----------|----------------|---------------------|---------|----------------|---------------------|------|
| Table 3-                   | -32. Mea  | ın (± Stand  | ard Deviation                  | ) Daily I             | Table 3-32. Mean (± Standard Deviation) Daily Beverage Intakes Reported on Beverage Frequency Questionnaire and 3-day Food and Beverage Dairies   | s Reported or             | n Bevera  | ge Frequency Q | uestionnaire a      | nd 3-da | y Food and Bev | erage Dairies       |      |
|                            |   |  |                                |                       |   |                           | Age       | ğe             |                     |         |                |                     |      |
|                            |   | 6 month  | 6 months $(N = 240)$           |                       | 12 mont   | 12 months ( $N = 192$ )   |           | 3 year         | 3 years $(N = 129)$ |         | 5 year         | 5 years $(N = 112)$ |      |
| Beverage                   | Oue   | Questionnaire                                      | Diary                          |                       | Questionnaire   | Diary                     |           | Questionnaire  | Diary               |         | Questionnaire  | Diary               |      |
|                            |   | mL/day <sup>a</sup>                                | $\mathbf{y}^{\mathrm{a}}$      | 9%                    | mL/dayª   | ıy <sup>a</sup>           | 9 %       | mL/dayª        | ay <sup>a</sup>     | 9%      | mL/dayª        | $1y^a$              | 9%   |
| Human Milk                 | 2(  | 204 ± 373  | $195 \pm 358$                  | 28.0                  | 9 ± 21  | $56 \pm 225$              | 12.6      | $NA^c$         | NA                  |         | NA             | NA                  | ı    |
| Infant formula             | )9  | $609 \pm 387$                                      | $603 \pm 364$                  | 85.8                  | $180\pm290$   | $139\pm251$               | 37.0      | NA             | NA                  |         | NA             | NA                  | 1    |
| Cow's milk                 | 2   | 24 ± 124   | 24 ±124                        | 6.7                   | $429 \pm 349$   | $408\pm331$               | 90.4      | $316\pm216$    | $358\pm216$         | 100     | $319 \pm 198$  | $325\pm177$         | 98.2 |
| Juice/juice drinks         |   | 56 ± 124   | $33 \pm 59$                    | 57.5                  | $151 \pm 136$   | $106\pm101$               | 92.2      | $192 \pm 169$  | $198 \pm 169$       | 6.96    | $189 \pm 169$  | $180\pm163$         | 95.5 |
| Liquid soft drinks         |   | 89 <del>∓</del> 9                                  | $0 \pm 0$                      | 1.3                   | 9 ± 30  | $3\pm15$                  | 20.9      | $62 \pm 71$    | $74 \pm 101$        | 74.2    | 74 ± 95        | $101 \pm 121$       | 82.1 |
| Powdered soft drinks       |   | $0\pm18$   | $0 \pm 0$                      | 0.4                   | $12 \pm 47$   | $3\pm18$                  | 10.5      | $62\pm115$     | $47 \pm 101$        | 51.2    | $74 \pm 124$   | 47 ± 95             | 52.7 |
| Water                      | 7   | 44 ± 80  | $30 \pm 53$                    | 61.7                  | $127 \pm 136$   | $80 \pm 109$              | 84.9      | $177 \pm 204$  | $136 \pm 177$       | 95.3    | $240 \pm 242$  | $169 \pm 183$       | 99.1 |
| Total                      | 76  | $940 \pm 319$                                      | $896\pm195$                    | 100                   | $905 \pm 387$   | $804\pm284$               | 100       | $795 \pm 355$  | $816\pm299$         | 100     | $896 \pm 399$  | $819 \pm 302$       | 100  |
| a Mean b Percei c NA = Nun | Mean ± standard deviation<br>Percent of subjects consun<br>NA = not applicable.<br>= Number of observations | deviation of<br>ts consumin<br>tble.<br>ervations. | all subjects.<br>g beverage or | Convert<br>n either o | Mean ± standard deviation of all subjects. Converted from ounces/day; 1 fluid ounce = 29.57 mL. Percent of subjects consuming beverage on either questionnaire or diary.  NA = not applicable.  = Number of observations. | /day; 1 fluid c<br>diary. | onnce = ; | 29.57 mL.      |                     |         |                |                     |      |
| Source: Marsh              | Marshall et al., 2003b.   | 003b.  |                                |                       |   |                           |           |                |                     |         |                |                     |      |



|                           |   | Table   | 3-33. Consur   | Table 3-33. Consumption of Beverages by Infants and Toddlers (Feeding Infants and Toddlers Study)  | erages by Ir  | nfants and Too  | ddlers (Feed              | ling Infants an                                      | d Toddlers S  | Study)  |                 |  |
|---------------------------|---|---|--|--|---|---|---------------------------|--|---|---|-----------------|--|
|                           |   |   |  |  |   | Age (1  | Age (months)              |  |   |   |                 |  |
|                           | 4-6 (N  | 4-6  (N = 862)  | 7-8  (N = 483)   | = 483)   | 9-11 (N = 679)  | (629 = L  | 12-14 (                   | 12-14  (N = 374)                                     | 15-18   | 15-18  (N = 308)                                      | 19-24 (         | 19-24  (N = 316)                               |
| Beverage<br>category      |   | Consumers Mean $\pm$ SD $\%^a$ mL/day <sup>b</sup>  | Consumers %a   | Consumers $Mean \pm SD$ 9% $mL/day^b$  | Consumers<br>%ª   | Consumers Mean $\pm$ SD Consumers Mean $\pm$ SD $\%^a$ mL/day <sup>b</sup> $\%^a$ mL/day <sup>b</sup> | Consumers<br>%ª           | $Mean \pm SD \\ mL/day^b$                            | Consumers<br>% <sup>a</sup>                                 | Consumers $Mean \pm SD$<br>$%^a mL/day^b$             | Consumers<br>%ª | Consumers Mean ± SD<br>% a mL/day <sup>b</sup> |
| Total milks <sup>c</sup>  | . 100   | 778 ± 257   | 100  | $692 \pm 257$  | 7:66  | $659 \pm 284$   | 98.2                      | $618 \pm 293$  | 94.2  | $580 \pm 305$   | 93.4            | $532 \pm 281$                                  |
| 100% juice <sup>d</sup>   | d 21.3  | $121\pm89$  | 45.6   | $145\pm109$  | 55.3  | $160\pm127$   | 56.2                      | $186\pm145$  | 57.8  | $275\pm189$   | 61.6            | 281 ± 189                                      |
| Fruit drinks <sup>e</sup> | se 1.6  | $101 \pm 77$  | 7.1  | 77 ± 86  | 12.4  | $157\pm139$   | 29.1                      | $231\pm186$  | 38.6  | $260\pm231$   | 42.6            | $305 \pm 308$                                  |
| Carbonated                | 0.1   | 86 ± 0  | 1.1  | 6 ± 9  | 1.7   | $89 \pm 92$   | 4.5                       | $115\pm83$   | 11.2  | $157\pm106$   | 11.9            | $163 \pm 172$                                  |
| Water                     | 33.7  | $163 \pm 231$   | 56.1   | $174 \pm 219$  | 6.99  | $210\pm234$   | 72.2                      | $302\pm316$  | 74.0  | $313\pm260$   | 77.0            | $337 \pm 245$                                  |
| Other <sup>f</sup>        | 1.4   | $201\pm192$   | 2.2  | $201\pm 219$   | 3.5   | $169 \pm 166$   | 9.9                       | $251\pm378$  | 12.2  | $198 \pm 231$   | 11.2            | 166 ± 248                                      |
| Total<br>beverages        | 100   | $863 \pm 254$   | 100  | $866 \pm 310$  | 100   | 911 ± 361   | 100                       | $1,017 \pm 399$                                      | 100   | $1,079 \pm 399$                                       | 100             | 1,097 ± 482                                    |
|                           | Weighted percentages, adjusted for over sampling, nonresponse, and under representation of some racial and ethnic groups.  Amounts consumed only by those children who had a beverage from this beverage category. Converted from ounces/day; 1 fluid ounce = 29.57 mL. Includes human milk, infant formula, cow's milk, soy milk, and goat's milk.  Fruit or vegetable just with no added sweeteners sweeteners. Includes beverages with hess than 100% juice and often with added sweeteners; some were fortified with one or more nutrients.  "Other" beverages category included tea, cocoa and similar dry milk beverages, and electrolyte replacement beverages for infants.  = Standard deviation. | antages, adjus umed only by a milk, infant: ble juices with lages with less ges category i sservations. | ted for over s. those children formula, cow I no added sw than 100% ju included tea, c | adjusted for over sampling, nonresponse, and under representation of some racial and ethnic groups. It by those children who had a beverage from this beverage category. Converted from ounces/day; Infant formula, cow's milk, soy milk, and goat's milk.  Is with no added sweeteners.  In hess than 100% juice and often with added sweeteners; some were fortified with one or more nutrie agory included tea, cocoa and similar dry milk beverages, and electrolyte replacement beverages for it ons. | esponse, an<br>everage fror<br>ilk, and goa<br>with added t | d under repre<br>n this bevera;<br>tt's milk.<br>sweeteners; ss<br>c beverages, t                     | sentation of ge category. | some racial an<br>Converted fri<br>rritified with or | nd ethnic gre<br>om ounces/d<br>ne or more n<br>t beverages | ups.<br>lay; 1 fluid our<br>utrients.<br>for infants. | ıce = 29.57 n   | ıl.  |
| Source:                   | Skinner et al., 2004  | .004.   |  |  |   |   |                           |  |   |   |                 |  |

|                        | Table 3-34.            | Pool Water Ingestion by Swimmers                     |   |
|------------------------|------------------------|--|---|
| Study Group            | Number of Participants | Average Water Ingestion Rate (mL/45-minute interval) | Average Water Ingestion Rate (mL/hour) <sup>a</sup> |
| Children <16 years old | 41                     | 37   | 49  |
| Males <16 years old    | 20                     | 45   | 60  |
| Females <16 years old  | 21                     | 30   | 43  |
| Adults (>18 Years)     | 12                     | 16   | 21  |
| Men                    | 4                      | 22   | 29  |
| Women                  | 8                      | 12   | 16  |

<sup>&</sup>lt;sup>a</sup> Converted from mL/45 minute interval.

Source: Dufour et al., 2006.